SCIENTIFIC AMERICAN

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A POPULAR ILLUSTRATED WEEKLY OF THE WORLD'S PROGRESS

Vol. CII.—No. 11.
ESTABLISHED 1845.

NEW YORK, MARCH 12, 1910.

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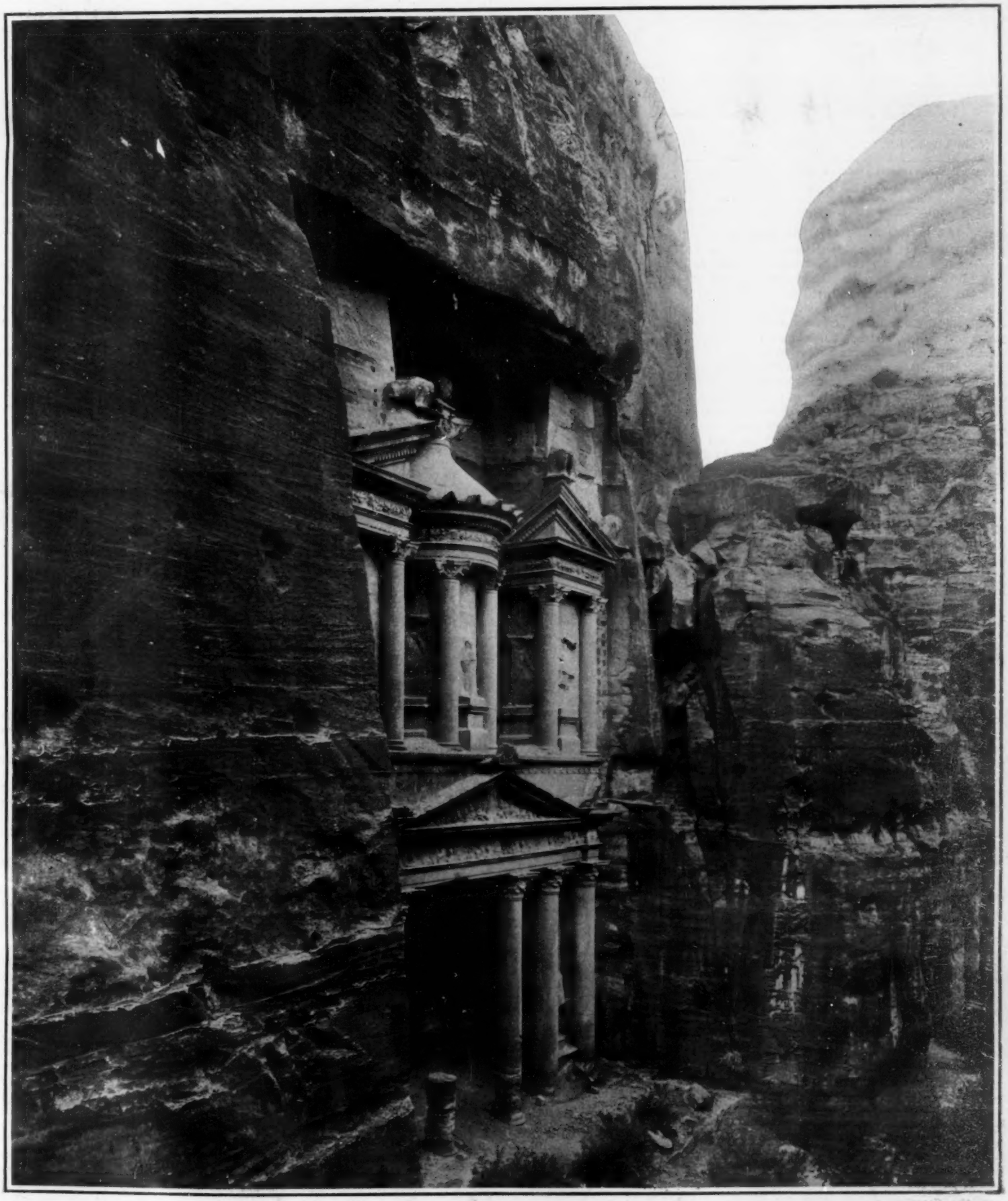
$3.00 A YEAR.



El Khazneh el Farioun (the treasury of Pharaoh) Petra.

This is in some respects the most remarkable of the beautiful temples and tombs of Petra, the rock-hewn capital of Edom, and later of the Nabataeans, whose king, Aretas, mentioned in 2 Cor. 11:32, extended his conquests as far as Damascus. This monument of antiquity is thought to be the work of the Romans, being attributed by some to the Emperor Hadrian who visited the place in A.D. 131. The color of the sandstone rock from which this vast monolith was cut is a delicate rose pink. The imposing façade shows two rows each of six majestic columns. It terminates in a miniature temple crowned by a huge urn said to contain treasures of Pharaoh. The angle at which the photograph was taken well shows how the temple was cut from the rock.

A CITY HEWN OUT OF SOLID ROCK.—[See page 220.]

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MUNN & CO., Inc., - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York.
FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York.

TERMS TO SUBSCRIBERS.

One copy, one year, for the United States or Mexico $3.00
One copy, one year, for Canada 3.75
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THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (established 1845) ..... $3.00 a year
Scientific American Supplement (established 1876) ..... 5.00 "
American Homes and Gardens ..... 4.00 "

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.

MUNN & CO., Inc., 361 Broadway, New York.

NEW YORK, SATURDAY, MARCH 12th, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE "WHIP-CREATION" BATTLESHIP.

THE Washington correspondent who is responsible for the distribution of naval and military news to the daily press of the country has been writing some extremely silly nonsense about the two battleships which the House Naval Committee has recommended for this year's programme, and he has put into the mouth of Secretary Meyer statements as to the objects which have inspired the request for these two powerful vessels, which we are perfectly satisfied the Secretary could never have uttered. According to the dispatches the motive responsible for their unprecedented size, reported to be from 30,000 to 32,000 tons, is the desire to build a couple of ships which shall be bigger than anything else afloat, and give to this nation the prestige of possessing battleships which, in respect of size and terror-producing qualities, shall be supremely of the "whip-creation" order.

It is sufficient to say, once and for all, that the day of whip-creation sentiment has long ago passed—if indeed it ever existed, except on the street or in the music hall ballad. Certainly it was never a motive in the upbuilding of the United States navy. Our frigates of the sailing days were built swifter and armed stronger than the ships then afloat in other navies, not for the vainglory of being able to say that they were swifter and more heavily armed, but for the very practical purpose of overtaking the enemy, bringing him to action, and crushing him by superior gun fire. The policy of that early time has been the policy of our navy in the intervening one hundred years, and it is its policy to-day. If Secretary Meyer believes it to be expedient to build a ship many thousand tons larger than anything contemplated abroad, we may rest assured that it is because he and his naval advisers believe that to maintain our traditional superiority in gun fire, we must move up from the 12-inch to the 14-inch gun, and increase our displacements in proportion.

The most efficient battleship is the one which embodies the maximum amount of all-round military efficiency on the minimum amount of displacement. Unless the present theories of naval designers are very much at fault, a ton of displacement in a big battleship gives more military value than it does in a ship of smaller size. Thus, 20,000 tons in a "Delaware" is a more valuable asset than the same displacement in two "Oregons." Here, then, is another cause of the rapid growth in recent years in the tonnage of the first-class fighting ship. From the 12,500-ton "Maine" our ships of the first line have grown through the 16,000 tons of the "Connecticut," the 20,000 tons of the "North Dakota," and the 22,000 tons of the "Florida," to the 26,000 tons of the two great vessels, "Arkansas" and "Wyoming," which are now upon the stocks.

The big jump of 25 per cent in displacement between the "Connecticut" and "North Dakota" was due to the coming of the dreadnought type and the adoption of an exclusive main armament of 12-inch guns. To-day, we are on the eve of another great advance, and again it is due to a great increase in the weight and power of the battery, this time by the substitution of the 14-inch for the 12-inch gun. The House Committee on Naval Affairs has accepted, we are glad to see, the Secretary's programme for increasing the force of the navy by two battleships, two fleet colliers, one repair ship, and four submarines of a new type of unusual speed and steaming radius. According to the provisions, the battleships are to be of at least 26,000 tons, and each ship is to carry ten 14-inch guns, the ships being made of sufficient displacement to carry this battery. The 14-inch gun, however, with its mount, ammunition, etc., is so much heavier than the 12-inch, that the new vessels, even though they carry two less guns, will have to be of at least 28,000 tons displacement, and if it should be decided to mount twelve such guns, the displacement may run up to 30,000 tons and over. Because of the greater punishing power of the 14-inch gun at long ranges, a battery of ten 14-inch would greatly outmatch one of twelve 12-inch. There is no ship afloat or contemplated, so far as we know, among the navies of the world, that could withstand such a vessel.

HIGH-SPEED TELEGRAPHY.

SOME very remarkable testimony has been elicited by the Joint Committee of the Legislature which is investigating the question of extending the jurisdiction of the Public Service Commission to and over telephone and telegraph companies. It is remarkable, as seeming to indicate that in spite of the large amount of thought, ingenuity, and mechanical skill which have been directed with marked success during the past few decades to the improvement of the speed and lowering of the cost of telegraphy, practically the whole of the business of the big telegraph companies is to-day sent by the hand-operated Morse key, in much the same way, and at no greater speed, than when Morse first made telegraphy a practical commercial art. Thus, according to the testimony of Col. Clowry, president of the Western Union, the maximum speed of transmission is obtained in their service by two systems, the Wheatstone and the Barclay, the former having a capacity of 125 words per minute, and the latter of 90, with an average of about 50 in practical use, and these two forms of apparatus, it would seem, represent the only departure made by the Western Union Company from their almost universal practice of operating by hand by the Morse key.

Side by side with this evidence, testimony was given that rapid telegraphy systems have been developed here and in Europe with capacities of from 500 to 1,000 words a minute and over, one system, established in several centers in the United States, being now in daily use which is sending messages at a rate of 1,000 words per minute. The public will naturally ask, if such high speed be possible, why do not the telegraph companies make use of the system, and so increase their capacity and make the corresponding decrease in rates. In his testimony Col. Clowry explained that the Western Union's is a one-message business, and that the company cannot hold messages until they get a sufficient number to send at a 1,000-word-a-minute rate. This is true as regards the single short message; but in the case of the longer messages approaching the manuscript letter length—the type of business which would be certain of enormous development if it were offered to the public, throughout the whole twenty-four hours of the day, at the low rates which would then be possible—it would be practicable to set half a dozen operators at work simultaneously in punching the sending tapes, and the message could be sent through in less than one-tenth the time that it would take by the present methods. The transmission of Peary's 8,000-word message from Indian Harbor to the New York Times was quoted as a great feat in telegraphy. It took a force of twenty operators three days to get the message through. By the rapid telegraphy system the same message, after being prepared on the tape, could have been sent over a single line in about ten minutes' time.

The high-speed methods, as worked out by Hughes, Murray, Pollak-Virag, and Delany, claim to send at the rates respectively of 4,500, 16,000, 36,000, and 60,000 words per hour. The significance of these methods to the public is that by their use the telegraph could be extended, cheapened, and popularized until it was as available to the ordinary citizen as the far more highly developed telephone of the present day.

NEW YORK AND PARIS SUBWAY SYSTEMS COMPARED.

NEW YORK CITY is justly proud of its subway system; but it will be a surprise to some of us to learn that the subway system of Paris actually carries a larger number of passengers during the year, the total being 282,000,000 as against 200,000,000 carried on the New York system. Outside of the mere fact that more people were carried, the comparison is entirely favorable to the New York subway. The details of the following comparison have been worked out by R. H. Whitten, the Statistician of the New York Public Service Commission, and they afford upon a most timely subject a mass of valuable information, which is a credit to the compiler and cannot fail to be of great service to the Commission in its important work of regulating transportation matters in this city.

There are certain points of similarity between the two subways. Both have been built and are owned by the city, and both are leased for a term of years to an operating company. The length of the two systems in miles of single track operated was in 1908, the year for which the latest figures are available, very nearly equal. But the Paris system, which is entirely two-track, forms a network of lines covering a district having a radius of three or four miles from the business or traffic center, whereas the New York system has a single stem terminating in two long forks at the upper end, and extending 14 miles to its most distant point from the Brooklyn Bridge, which may be called the chief traffic center. The Paris subway has no express service, whereas the New York subway has four tracks, carrying express and local service for six and a half miles through the most congested district.

The population of the district served by the subway system was 2,750,000 in New York and 2,790,000 in Paris. The area of the city proper of Paris immediately tributary to the subway is 31 square miles; the area of Manhattan and the Bronx served by the subway is 62 square miles. Hence the population of the district served by the Paris subway is more than twice as dense as that served by the New York system. There is a total of 64.6 miles of single track in the New York and of 62.2 miles in the Paris subway.

The great superiority of the New York system is due to the frequency of the trains and the higher speed of travel. In Paris during 1908 the least headway during rush hours was 2 minutes and 33 seconds and the greatest 7½ minutes. The least headway in the rush hours of the express trains in New York was 2 minutes and the greatest 4 minutes. The maximum length of the Paris train was 236 feet; of the New York train, 411 feet. The average speed in the Paris subway is 12 miles per hour; and in the New York subway, 18 miles per hour; the average speed of express trains between Brooklyn Bridge and 96th Street being about 24 miles per hour and the average speed of the local trains about 15 miles per hour. The maximum speed in the New York subway is 40 miles per hour, as against 21.7 miles per hour in Paris.

The rates of fare in Paris are first class 4.8 cents, second class 2.9 cents, and second class round-trip tickets 3.8 cents, equivalent to 1.9 cents per trip. In New York there is a uniform fare of 5 cents; but while the fare in New York is 5 cents, the average length of ride per passenger is from two to two and a half times that in Paris.

In Paris the capacity of each car is determined by the government, and in 1908 the average number of passengers per car was 64. The capacity of the New York cars both seated and standing, estimated on the Paris basis, was 103; but this frequently rises to 150, and even 170 passengers per car. In Paris the number of standing places is fixed by the government; in New York the limit is apparently fixed by the ability of a burly platform guard to boost the passengers in by a well-directed football rush. But were the government allotment of floor space, as obtaining in Paris, applied in New York, the maximum capacity of a New York subway car would be cut down from 170 to 103. The number of passenger-place-miles per mile of track was 73,000,000 for New York and 36,000,000 for the Paris system, and yet, as we have seen above, the Paris subway, because of the shorter length of the trips, carried a greater number of passengers in the year.

Congestion in Paris is not nearly so great as in New York, first, because traffic is more evenly distributed throughout the day; secondly, because the currents of traffic in Paris move in both directions during the rush hours; and thirdly, because the passenger in Paris takes a shorter average ride, and vacates his place for others. The longest possible ride on the New York subway is 17½ miles; though it is not probable that many people take the trip from Atlantic Avenue, Brooklyn, to 222nd Street, New York, for the pleasure of the trip, and certainly not many for business purposes. The total cost of the New York subway and its equipment was $87,938,000, consisting of $51,290,000 actually paid by the city for the construction of the subway and $36,648,000 that the company claims to have expended for both equipment and construction, including $10,048,000 which it claims to have spent in the construction of the subway from Brooklyn Bridge below Broadway and the East River to Brooklyn. The total cost of the construction and equipment of the Paris subway is estimated at $62,252,000.

The New York subway fared much better than the Paris subway in the matter of taxes, the former paying but $900 per mile of single track as against $4,300 per mile paid by the Paris subway. The New York subway considered as an economic undertaking earned about 7 per cent on the capital invested, while the operating company earned about 11 per cent on its reported investment. The Paris subway earned 7½ per cent on the total estimated cost of construction and equipment, and the operating company earned 8 per cent on its reported investment.

ENGINEERING.

A recent wreck on the London & Brighton Railway, England, when an express left the rails and crashed into the railway station, has again illustrated the light construction of English cars. A Pullman car was comparatively little damaged, whereas the ordinary day coaches were completely wrecked.

The new single-phase electric freight locomotive which has been built for the New Haven Railroad was recently given a test between New Rochelle and Stamford, a distance of 17 miles. The load consisted of thirty loaded freight cars, and the distance of 18 miles was covered in 27 minutes without pushing the engine to its full capacity.

In a paper before the Engineers' Society of Western Pennsylvania, E. F. Bulmahn described a new type of bituminous gas producer which embodies the good features both of the up-draft and the down-draft type, overcoming the production of tar and completely consuming the fixed carbon. There are two fuel beds, one operated as a down-draft producer to break up the volatile matter, the other as an up-draft producer to consume the fixed carbon, the resultant gas being taken off at the center of the producer.

Time was when it took nearly six years to build a battleship in private yards in the United States; but the construction of the "Connecticut" at the government yard at Brooklyn set a pace which has steadily accelerated. The "Mississippi," whose trials took place as recently as October, 1907, took 44 months to construct. The "New Hampshire," December, 1907, was built in 36 months; the "North Carolina" (cruiser), January, 1908, in 36 months; "Michigan" (battleship), 1909, in 34½ months; the "Delaware" (battleship), October, 1909, in 27 months.

Vast improvements are being made in the Trans-Siberian Railway which, in addition to being double-tracked, is being largely relocated with a view to the elimination of grades and the shortening of distance. When the work has been completed, the distance from Paris to Peking will be 6,300 miles instead of 7,500 miles over the present line *via* Harbin and Mukden, and the fourteen days now consumed on the trip will be reduced to nine and a half days. The value of these improvements will be as great from the military point of view as they will from that of passenger and freight traffic.

Speaking on the relative economy of the single-phase and direct-current systems for steam railroads, Mr. George Gibbs is of the opinion that maintenance costs of the single-phase system as at present developed will be somewhat higher than for the direct current, though eventually they should be about the same. On the other hand, he estimates that about 13 per cent less energy would be required at the power house for the single-phase than for the direct-current system. Adding the saving in sub-station operation, he looks for a saving of from 4 to 5 per cent in the total operating cost in favor of the single-phase system.

The tremendous floods of the past season on the Isthmus of Panama have helped to demonstrate, even before completion, the wisdom of building a high-level rather than a sea-level canal. Through the swamp near Gatun the bottom of a sea-level canal would be some 50 feet below the general ground level, and at Gamboa, where the Chagres River pours its enormous and sudden floods across the canal cut, the river bed would be 90 feet above the canal bottom. Under the torrential downpour, the discharge of alluvial silt into the canal would make necessary constant dredging, and might result in the temporary obstruction of the channel.

There is great activity just now in experimental work in the direction of speed-reducing gears for marine turbines. We noted in our issue of February 12th that the Melville-MacAlpine mechanical gear has shown a shop efficiency of 98.5 per cent. The Parsons Marine Steam Turbine Company have installed a helical reduction gear on the 1,000-ton steamship "Vespasian," with which they claim to have obtained a shop efficiency of 99 per cent. The Dr. Foettinger hydraulic reduction gear has shown an efficiency of 80 per cent. This last-named gear, however, is said to have the great advantage of being quickly reversible.

Prof. O. Paul Moncton of Calcutta sends us a preliminary description of an enormous steel tank, 330 feet square by 6 feet deep, carried on steel columns at a height of 90 feet from the ground, which has been built to act as a reservoir for the water mains of the corporation. Because of the limited bearing capacity of the local silt underlying Calcutta, the tank has been built upon a monolithic bed of concrete weighing 26,000 tons. The tank itself weighs 10,000 tons, and the water about 40,000 tons. The supporting columns are in groups of four, braced together; but as a precaution against the action of earthquakes the groups are not interbraced, the object being to prevent excessive vibration and to provide a certain flexibility. The cost of the tank was $600,000.

AERONAUTICS.

The latest German airship—"Parseval V."—left Bitterfeld at 10:15 A. M. March 1st on a voyage to Berlin. The capital city was reached safely, the 80 miles being covered in 4 hours. This airship is the smallest non-rigid passenger-carrying dirigible yet constructed. Its length is but 30 meters (90 feet).

With the same make of 50-horse-power revolving-cylinder motor used by the ill-fated Delagrange, and which drove his machine at the rate of 50 miles an hour, Le Blon flew 10 kilometers (6.21 miles) in 8:7 4/5 (45.83 miles per hour) and Balsan 5 kilometers (3.1 miles) in 4:1 (46.38 miles per hour) at the first foreign aviation meet of the year at Heliopolis, near Cairo, Egypt. Both were awarded prizes.

The 1910 model Bleriot monoplane has a body only 6.6 meters (21.64 feet) in length. The body is completely covered. There are wide horizontal fins on each side at the rear, forming a tail, and the horizontal rudder is in two parts, one of which is hinged to the rear edge of each fin. The tail resembles that of the Antoinette monoplane, but Bleriot still uses a rectangular-section body instead of the V-shaped form which imparts to the Antoinette machine its excellent transverse stability.

The recent decision of Judge Hand against Paulhan in the Wright brothers' suit, the granting of a preliminary injunction, and the requirement of a $25,000 bond for one month in case Paulhan wished to continue his flights, has put a sudden end to the making of exhibition flights in America by this daring record-breaking Frenchman. The bond was reduced to $12,000, but Paulhan's manager, although under contract to pay him $6,000 per week, has brought the aviator to New York to await the result of an appeal. The case will be reopened on the 12th instant.

Gen. Brun, the French Minister of War, a month ago inspected at Villacoublay the four Wright biplanes which have been built for the French army. Count Lambert explained the mechanism but made no trial flight because of an extremely high wind. At the same time the army Antoinette and Farman machines were inspected at Mourmelon by an artillery officer, Commandant Estienne. On the 3rd ultimo Van den Born made a 35-minute flight in one of the Farman biplanes, carrying a useful load of 201 kilogrammes (443 pounds). On March 1st Lieut. Cammaran of the Engineer Corps flew 38 miles in a similar machine. Bleriot also has been instructing Lieut. Aquaviva with success.

A man who has made a thorough investigation of the accident to the Bleriot monoplane which cost the life of Leon Delagrange, has concluded that the accident was the result of the aviator getting "rattled" for an instant when he was flying low and was about to turn. It is this man's belief that Delagrange threw his control lever too far to one side—thus warping the wings too much and tipping the machine severely—and then too far to the other, the result being that the machine swayed so violently that it turned over. It struck the ground upside down, and all the guys, etc., on the under side were found intact. A spacing strut between the wings (which the constructor claimed had been left out) was found in place and unbroken. As far as could be ascertained, everything was in good order and the accident was not due to the failure or breakage of any part of the mechanism.

Now that Germany has produced several "men birds," many new aeroplane inventors are rapidly appearing. The majority of these favor the monoplane, with which type the first $10,000 cash prize (the Lanz prize) was won by Herr Grade last fall. Dorner and Hilsman are two of the latest successful experimenters with this type of aeronef—to whom should be added Major von Parseval, who has a huge 14-meter (46-foot) span monoplane fitted with a 114-horse-power motor. This machine is undergoing its preliminary tests on the shore of the lake at Plau in Mecklenburg. On March 1st Herr Paul Lange attempted the first aeroplane flight to be made at Dresden. He rose to a height of 40 feet, when a violent wind gust capsized the machine, which fell and was badly demolished. The aviator escaped with bad bruises.

The making and flying of model aeroplanes is a scientific diversion from which much may be learned. Several interesting new forms of aeroplanes have been developed from models, and many amateurs have learned the behavior in flight of the various types of machines. Hence the first national contest of the Aeronautic Society for the Chanute cup and other prizes, which was held in the 69th Regiment Armory, New York city, on the evening of March 3rd, was largely attended. Several small monoplanes having planes made of wood were flown by L. J. Lesh. Mr. Dalkranian had a Langley-type machine with 4 large propellers, one at either corner. All the models were launched from a table. The longest flight—148 feet—was made by the monoplane of Frederick Watkin, a 15-year-old boy. Other contests will be held weekly in the armory.

SCIENCE.

Prof. Herschel C. Parker of Columbia University announces his intention of attempting to ascend the Alaskan peak, Mount McKinley. He states that either he will reach the summit or prove that it can be reached only by an aeroplane.

The alcohol produced from sawdust and wood must not be confused with wood alcohol, for, although standard alcohol is primarily made from wood, it is produced directly by the fermentation of a pure sugar solution, into which the wood is first converted, and it is the same, both chemically and physically, as the alcohol made from grain.

Knud Rasmussen, the explorer, will sail in June for Greenland on an expedition which will consume four years. The ethnographic study of the Eskimos is the purpose of this expedition. One year will be spent at Cape York and a year each at Hudson's and the Crown Bays. After the navigation of Baffin's Bay, Rasmussen expects to circumnavigate Alaska and to sail to the Aleutian Islands and return *via* San Francisco.

Sir Ernest H. Shackleton, the Antarctic explorer, who is to lecture in this country, will arrive on the "Lusitania" on March 25th. Before the explorer leaves Washington, where he will be the guest of Ambassador Bryce, he will receive from President Taft the gold medal of the National Geographical Society. While in New York he will be presented with the gold medal of the American Geographical Society of New York.

Prof. E. E. Barnard of Yerkes Observatory informs us that on February 27th last he obtained with a one-hour exposure a photograph of Halley's comet, showing a faint tail of two degrees, equivalent to a length of about fourteen million miles. This is rather important in relation to the question as to whether the tail will reach the earth on May 18th. From these photographs, taken so far from perihelion, it seems that the tail will be amply long enough to reach the earth.

The Royal Geographical Society of Italy, at a largely attended meeting, ratified the recommendations of the committee relatively to the bestowal of medals and other distinctions for the year 1909. These include a gold medal to Robert E. Peary, for the discovery of the North Pole; silver medal to Captain Robert A. Bartlett, who commanded the steamship "Roosevelt" on the Peary expedition; gold medal to Lieutenant Sir Ernest H. Shackleton, for his "nearest South Pole"; silver tablet to the Duke of the Abruzzi, for his expedition to the Himalayas, where he made a record ascent.

The moving picture is now applied to educational purposes. Chemical tests are now exhibited on the screen. There are films illustrating the electrolysis of water, action of nitric acid on silver, and action of aqua regia on metallic gold, etc. The test tube is thrown on the screen many times enlarged, and the chemical action is clearly illustrated. Most unsavory but educational is a film illustrating the peril of the fly. The flies are shown laying eggs in unsavory places, and before the eyes of the spectators the eggs develop in heaps of wriggling maggots. In the final stage the winged fly is shown in all its unsanitary glory. Still another film exhibits the acrobatic fly lying on its back juggling various articles with its feet, and even swinging a dumb-bell as large as the insect itself.

In the possession of Knox Hall of Natural History with its invaluable specimens, Hamilton College is especially fortunate. By the kindness of the Hon. James Knox, LL.D., '30, the original building was reconstructed into a hall suited to the display of all sorts of natural history specimens. The most important collection on exhibit is that of the New York State minerals, together with related minerals from Canada. Among these specimens are found many rare ones, the best of their kind in existence. In addition to these minerals are 2,400 specimens of fossils and rocks to illustrate the geology of New York; 1,750 specimens to illustrate the geology of the United States; 600 fossils, mainly from the Silurian formation of Europe. Several thousand valuable specimens in paleontology, 10,000 specimens of ores and minerals, 2,000 specimens of land, fresh-water, and marine shells, 300 specimens in ornithology from China, 13,000 specimens in entomology, supplemented by a fine group of specimens in ornithology and comparative anatomy. A rare collection of Japanese shells and insects. A large and useful exhibition of the North American flora, the result of fifty years of botanical study, search, and correspondence. A large and valuable collection of butterflies, appropriately mounted. The Hall of Natural History is under the charge of Prof. William John Miller, Ph.D., an eminent authority on geology and mineralogy. Dr. Miller recently wrote a treatise on "The Geology of the Remsen Quadrangle," including Trenton Falls and the vicinity in Oneida and Herkimer counties. This book was published by the University of the State of New York as Bulletin No. 126 of the Education Department.

DRIVING PILES WITHOUT A PILE DRIVER

BY GEORGE H. LODGE

It may be of interest to many of the readers of the Scientific American to learn of an easy method of driving piles through the ice without the use of a pile driver.

Those who have tried to drive even a small post by hand while working in water or from a small boat, have found it much more difficult than one would at first suppose. I was myself confronted with the problem of building a dock landing for a lake steamboat—a steamboat built to carry 300 passengers, being 70 feet long. The problem was to build a dock or landing safe and large enough to handle the people rapidly.

First we thought that it would be necessary to hire a pile-driving outfit, but my father, R. H. Lodge, devised a plan that works to perfection.

We select straight white oak piles not over one foot in diameter at the butt, which are cut to the length required, usually from 20 to 36 feet. These are sharpened at the butt ends to a point, and with an ax a thread is cut from the point of the stick back from three to four and one-half feet, according to the size of the pile.

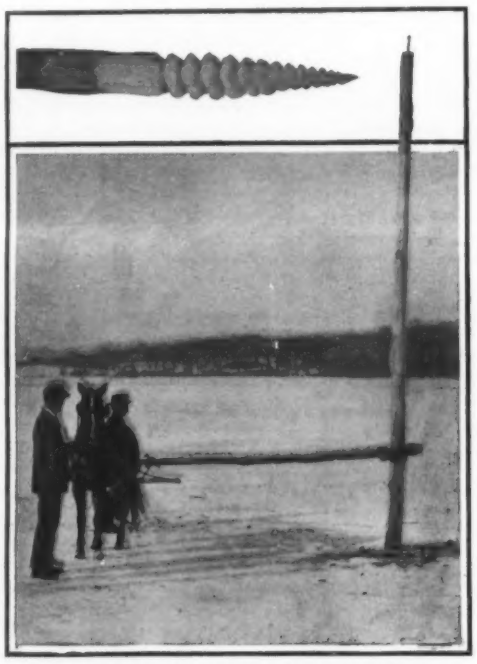
It is important that the threads be cut as nearly the same distance apart as possible. A good man with an ax can soon cut threads that are mechanical. It is astonishing how many, with a little practice, can be cut in a day. It pays to use special care in the cutting, as it helps wonderfully in the driving. Piles that are from ten to twelve inches in diameter should have threads from three to three and one-half inches apart and two to two and one-half inches deep.

After the threads are cut the pole is ready to drive, which is done by chopping a hole through the ice at the desired spot, being careful not to make the hole over two inches larger in diameter than the pole, and have the ice act as a guide to keep the pole upright while screwing it down.

If the pole is long and heavy, it is necessary to fasten three guy ropes to the top of it before raising. After the pole is raised, it is an easy matter to keep it plumb by pulling the ropes.

The pile is raised like a common telephone pole, in other words, a little at a time with pike poles, following up under with two planks spiked together in the form of an X.

It is a good plan to stand a plank in the hole and to let the point of the pile rest against it, as it assists in placing the pile in the desired spot.



DRIVING PILES WITHOUT A PILE DRIVER.

It is also a great help to spike a short plank across the pile, temporarily, just above the threads, to keep the pile from shooting under the ice before it is vertical, whereupon it may be knocked off. The pile will then drop into the proper place.

Now you are ready to bind a pole (or sweep lever) to the pile. This is done with a common log chain, care being taken to bind it so that it can be screwed in the right direction. Hitch a sharp-shod horse to the outer end and lead him around the pile (capstan fashion).

It is an easy matter now to screw a large pile from four to eight feet into solid clay or gravel or to unscrew it and remove it.

The accompanying photographs illustrate the wooden threads ready for use, and the plan of screwing in a left-hand threaded pile by the aid of a horse. We often put in smaller poles by hand, using two or three men instead of a horse.

We have recently taken out two steamer tie posts that have been in use for eight years, having begun to decay. These unscrewed posts we found had been in sixteen feet of clay and quicksand. It was necessary to hitch the lever below the water line, where the wood was sound, in order to start them.

To the Cairo Scientific Journal for January last Mr. B. F. E. Keeling communicates an interesting paper on climate changes in Egypt. There is a strong belief among residents that changes have occurred within the last ten or twenty years (possibly due to increased irrigation) which are distinctly "sensible" without the aid of instruments. Mr. Keeling quotes the mean temperature at Abbassia for each pentade from 1870 to 1904, and for the four years 1905-8; but the results show that the differences are hardly greater than might be caused by difference of exposure of the thermometers. As regards humidity, also, there is very little evidence of any decided change during the last forty years. It is confidently asserted by many persons that the rainfall has increased during quite recent years, but the author shows that there is little, if any, evidence of such being the case. The total rainfall of any year is often influenced by the fall on a single day, and is consequently very variable from one year to another; the driest year on record at Abbassia is 1892, with little more than a quarter of an inch of rain, and the wettest, 1904, with less than 3 inches, the mean for 1887-1908 being approximately 1.4 inch.

AN ARTISTIC REINFORCED CONCRETE BRIDGE

A COMING TYPE FOR COUNTY HIGHWAY BRIDGES

In country districts where the materials are readily accessible, the reinforced concrete bridge should prove to be an ideal system for the construction of concrete bridges of moderate span. We say of moderate span, for the reason that the art of trussed bridge construction in reinforced concrete is as yet in too early a stage of its development to warrant its indiscriminate use in bridges of considerable span. In structures of moderate length, say up to about eighty or a hundred feet, if care is taken in proportioning the parts, especially at the joints, and very particular care is taken in securing a thorough bond between concrete and steel, the county commissioners or other authorities should find the concrete steel bridge a reliable and economical type. It is easy to erect; it requires no painting and practically no maintenance whatever; it is indestructible by fire or the action of the weather; and its subsequent cost for maintenance should be practically nothing at all.

The accompanying illustration shows a bridge of this class, of the bowstring type, which was recently built in Canada. It has a span of 80 feet and provides a clear roadway 16 feet wide. The total weight is about 160 tons, and it contains about 13 tons of reinforcement in the form of plates and round rods.

The bridge was designed to carry a load of one hundred pounds per square foot evenly distributed, and it was tested for this load with an additional load of 35 tons represented by a herd of 70 cattle.

On the score of appearance it must be conceded that the design is decidedly pleasing, the intersection of the balustrade with the chord and web members having been worked out with considerable taste. The structure spans the Etobicoke River, in the counties of York and Peel, Canada.

A REINFORCED CONCRETE BRIDGE OF ARTISTIC DESIGN.

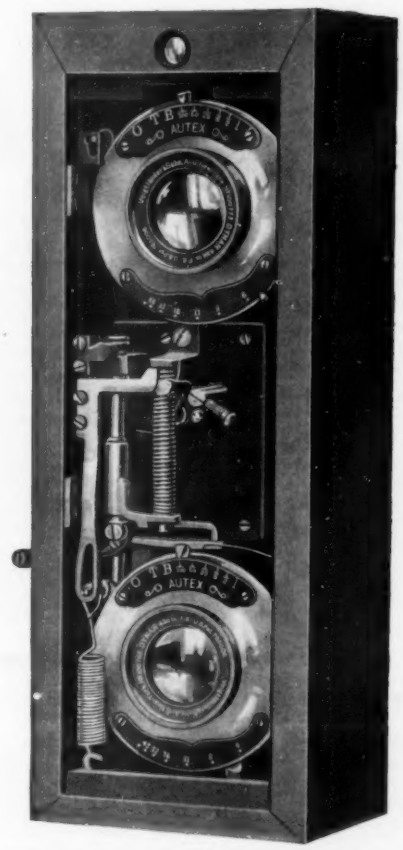
No sooner had the first modest attempts to steer ships by aerial electric waves been crowned with more or less success, than endeavors were made to direct the course of balloons and aeroplanes in the same manner. The American engineer Anthony has made experiments off Sandy Hook, with a small unmanned dirigible balloon, which he succeeded in guiding more than a mile seaward and bringing back to the point of departure. Prof. Wiechert suggests the employment of unmanned aeroplanes for the study of atmospheric electricity and has designed an apparatus of this kind. It is obvious that such an apparatus, equipped with the necessary instruments, which could be sent to great heights without danger and brought back with certainty, would be much more useful for the study of the atmosphere, and especially that of atmospheric electricity, than unmanned registering balloons, the recovery of which is always a matter of chance, or manned balloons and kites, the use of which is not unattended with danger in stormy weather. Balloons controlled from a distance by electric waves would also be very useful in the rescue of shipwrecked persons and for many military and other purposes. But —and this objection applies also to the wireless direction of ships and torpedoes—it is a long step from successful experiments in favorable conditions to uniform success in practical use.—Prometheus.

Instrument for Detecting Violations of the Speed Laws

BY L. GORDON GLAZIER

A very ingenious instrument for recording the speed and license number of an automobile has been devised by two instructors of the Massachusetts Institute of Technology. The instrument, which is but little larger than a pocket kodak, consists of a double camera with a watch movement which controls the operation of the camera shutter.

When an automobile passes at a speed that seems excessive, the operator trains the instruments upon it and releases the mechanism by pressing a button. Immediately the shutter of the upper camera is sprung,



DOUBLE CAMERA WITH WHICH VIOLATIONS OF THE SPEED LAWS ARE DETECTED.

taking a photograph of the receding automobile, and a moment later the other shutter is sprung, taking a second image of the automobile, whereupon the timing mechanism comes to a stop. The plate is developed by the regular process, and the resulting negative shows an image of the automobile near the operator with its license number distinct, and a second view of the machine taken at the end of the time interval. In the center of the print are the photographs of the hands of the stop watch caught when the first and second exposures were made.

Since the automobile has traversed a certain space in the time interval, the second image is smaller than the first by an amount which can easily be measured with an ordinary scale, divided in hundredths of an inch; and knowing that the standard wheel tread is 56 inches, the distances of the two objects from the camera and hence the space the automobile has covered in the time interval is easily found by the following law: The distance of any object from the lens is as many times greater than the focal distance of the camera as the length of any line of the real object is greater than its length in the photograph. This is a simple proportion in which three of the terms are known, namely, the size of the object, the size of the image of the object on the plate, and the distance of the image from the lens. The fourth term of the proportion, the distance of the object from the lens, follows by simple division. However, the operator is saved all irksome computation by a table attached to the instrument.

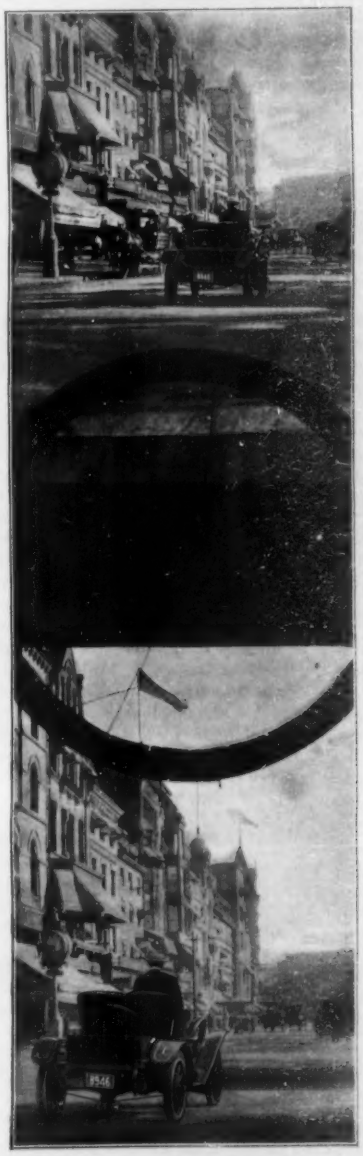
To overcome the possible objection by the courts, the watch has been designed so that the operator of the instrument may actually see it during the process of taking the picture. This is made possible by simply boring a hole from the outside of the camera box to the back of the watch, which brings to view a dial around which travels a hand attached to the same pinion or staff as the regular hand of the watch. In order to see this dial more plainly, two mirrors have been placed permanently in such a manner as to illuminate it.

The instrument gives extremely accurate results, and can be calibrated from time to time on objects of known speeds.

The inventors believe that the instrument should be welcomed by autoists as well as police. "It is an impartial judge, the personal element being entirely eliminated. A motorist who has been stopped does not have to rely on an officer's estimate of the speed, nor on the speed claimed by the officers operating a trap by means of stop watch and signals. Dozens of motorists are fighting cases every day who honestly believe that they were not overspeeding when stopped. They would be perfectly willing to pay their fines if convinced they were violating the law. Even where the more rational view is taken that the speed alone shall not determine whether or not a man is violating the law, but that the speed taken in connection with the surroundings shall determine it, it is always a question of the officer's word against the autoist's as to surroundings. This photographic speed recorder shows whether there were several vehicles near the automobile, whether people were crossing the street, whether it was more than ordinarily dangerous to run at the speed indicated, or more than ordinarily safe.

A great advantage of the instrument is that it records speed over a short distance. In the congested portions of cities, near crowded cross streets and in similar situations, it offers the only existing method of measuring momentary bursts of speed. The record of any reckless driver can be easily obtained, and a print sent directly to him, when he cannot deny the evidence of his own eyes, and in many cases an arrest will not be necessary, as the offense will not be repeated.

Regarding the legality of this speed recorder, in a recent case that was strongly contested Judge Hammond of the Massachusetts Supreme Court said: "The result of the evidence did not depend upon the fluctuations of human agencies nor on conditions where relations to results were uncertain, but upon the immutable working of natural laws; and upon the



SPEED OF AN AUTOMOBILE SHOWN BY TWO CONSECUTIVE PHOTOGRAPHS

evidence the presiding judge may well have found that such experiments were likely to be more reliable as to the speed of the automobile than the conjectural statement of an eyewitness or the interested statement of a chauffeur."

Sacrificial Compliments Paid to New Buildings in Antiquity.

A superstition that still envelops a great part of the earth is that especial firmness may be given to a building and that it may be protected from hostile influences by inclosing a living creature, preferably a human being, in one of the walls of the building itself. This belief, which is particularly prevalent in the Balkan peninsula and, for instance, has given to the Roumanian Queen, Carmen Sylva, material for one of her most beautiful folk tales, has not been known as having had any hold in Italy hitherto. Recently, in the course of archæological research, it was found that in the foundation of the Temple of Fortune in Pompeii there was a hollow space in which nothing other than the shell of a tortoise was found which time had broken into four pieces. Here, consequently, was proof of the precise immurement of a tortoise, which was enhanced by the disposition of the square blocks of stone of the creature's prison. In Italy this superstition may have passed at an early day into oblivion, as the sacrifice of human beings was foreign to the Roman religion, and was practised occasionally only under Greek influence. As, however, the sacrifice of human beings among the old Greeks was not unusual, and in Greece as well as in the adjacent countries the tradition of sacrifice to new buildings is still insistent, it may be believed that in old Greece also the sacrificial compliment to new buildings was not unknown. Instances of this kind of sacrifice in antiquity are certainly not frequent; all those of which we have any knowledge are attributed to the Greek Orient. Usually a maiden was sacrificed who, at the same time, became the guardian spirit of the structure. For this reason Trajan effected the erection in the theater at Antioch of the statue of the girl who has been sacrificed on the occasion of the reconstruction of the city after an earthquake and was designated as Tyche, the Goddess of Fortune of the scene of her sacrifice. It is this idea which still lies to-day at the root of this superstition of sacrificial compliment. Solidly a human being is incased in a wall of a house or other building, so that its soul may live in the structure and never escape from it. At the present day a vicarious sacrifice takes the place of such immolation. The human sacrifice is practised symbolically only, either by taking the measure of a person, or of the shadow, and immuring the string representing the measure or by incasing in the wall an animal already killed or still alive. Manifestly such a vicarious sacrifice is the tortoise of the Pompeiian temple, and probably the tortoise was selected because this animal can live a long time without nourishment, and the builders believed that the charm was more effective the longer the entombed creature lived.

The Hangman's Rope.

When death is caused by hanging, what proportion does the pull to which the rope is subjected during the struggles of the victim bear to the weight of the body? This novel question has been asked, and answered by experiment by Dr. Angelo de Dominicis. The tension in each case was measured by a dynamometer attached to the rope. A living dog, suspended in such a manner that it remained quiet, exerted a pull of 20 pounds, but the subsequent "hanging" of the same animal produced a pull of 42 pounds. With a larger animal the corresponding tensions were 50 pounds and 103 pounds.

Hence it appears that the convulsive movements of the victim may increase the tension of the rope to more than twice the weight of the body. This result explains the occurrence in the bodies of persons killed by hanging of serious lesions which it would be difficult or impossible to produce by hanging up a corpse. The strength of the rope must also be taken into account. If a body is found suspended by a rope, the breaking strength of which is little greater than the weight of the corpse, it may fairly be inferred that the body was not suspended until after death. Hence the experiments furnish valuable data for determining the cause of death in such cases and will probably be made use of in some future detective story.

JUPITER AND HIS SATELLITES

BY PROF. FREDERIC R. HONEY, TRINITY COLLEGE

Jupiter and his satellites command especial attention at the present time, owing to the fact that this greatest of all the planets, and second only to Venus in brilliancy, is approaching opposition which will be reached on March 30th. Jupiter will then be both morning and evening star.

The comparatively recent increase in the number of Jupiter's satellites from four to seven and possibly eight, as revealed by the growing power of the telescope, directs the astronomer's curious scrutiny upon the Jovian system. The satellite which is nearest the planet revolves around its great primary in the short space of twelve hours, at a distance of only 68,400 miles from the surface; while the outermost moon shows its extreme remoteness from its center of attraction (the enormous distance of 7,430,000 miles) by a revolution requiring 265 days. Thus is exemplified a perfect conformity to Kepler's laws. A small magnifying power reveals the elliptic outline of Jupiter, whose polar depression is extremely marked, the equatorial and polar diameters showing a difference of over 5000 miles.

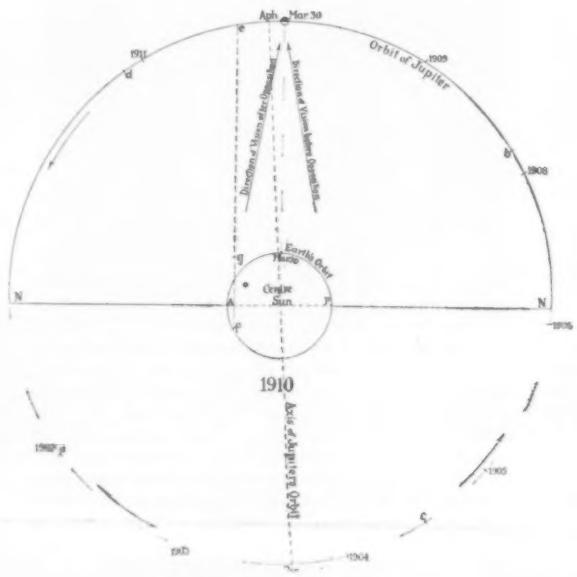
In the plot of the orbit Jupiter's position is shown for the date of opposition, which is very near aphelion; also for the oppositions from 1902 to 1911 inclusive. The average interval between oppositions is 399 days. But, in obedience to Kepler's second law, the planet's velocity at aphelion is diminishing. The last opposition occurred on February 28th, 1909; and the next will occur on April 30th, 1911. At perihelion the velocity was accelerated. The dates of the oppositions, which occurred before and after the perihelion passage, were respectively September 11th, 1903, and October 18th, 1904.

The five inner satellites revolve in orbits whose planes very nearly coincide with that of Jupiter's equator. This plane forms a small angle with the ecliptic, and may be represented approximately by a straight line. (Fig. 1.) The distances from Jupiter to the satellites are represented by the same scale as the planet. It is impossible to show the positions of the two outer satellites by this scale within the limits of this page, since their distances from Jupiter are over six times that between the planet and Callisto. It should be noted that all the satellites are never on the same side of the planet at the same time, as shown in the figure. This view of the satellites' orbits is obtained when Jupiter reaches the positions *A* and *B* shown in the plot of the orbit. When Jupiter is near either of these points, the five satellites appear to move back and forth in straight lines; and at every revolution of each satellite there is alternately a transit across Jupiter's disk and an occultation by the planet. Fig. 1 shows Jupiter and the orbits as seen from the earth in 1908. In 1902 this figure was reversed. During Jupiter's revolution around the sun in 11.86 years, the planet and the satellites are continually changing their positions relative to the ecliptic. The plane of the orbit is inclined at an angle of 1.3 deg.; and that part which is above the ecliptic is represented by the full line. The line joining the points *N* and *N'* (the ascending and descending nodes) is the intersection of the plane of the planet's orbit with that of the ecliptic. In Plot 1 a visual ray *A* from the earth tangent to the planet shows that, seen in this direction, Callisto is no longer occulted by Jupiter. Between the positions *A* and *C*, and between *B* and *D*, the orbits very gradually open out to the elliptic form; and at *C* and *D* the length of the minor axis reaches its maximum.

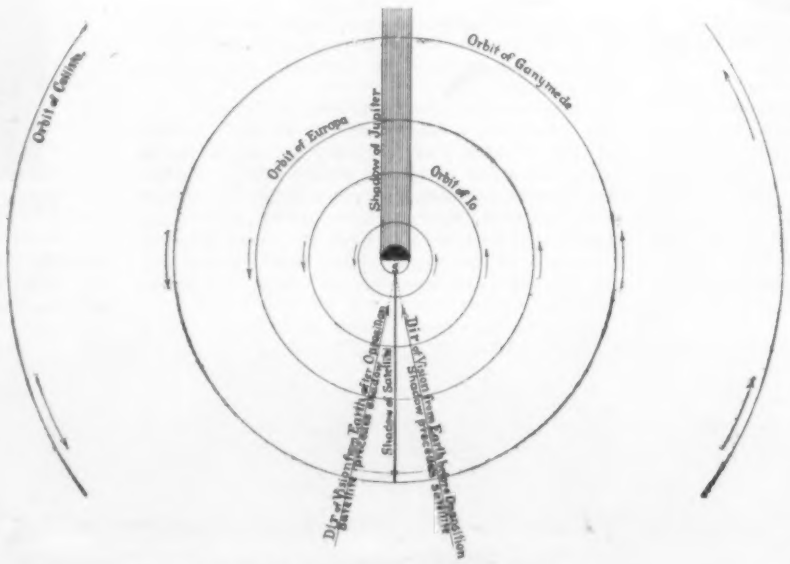
Fig. 3 represents the orbit of Callisto when the satellite no longer suffers occultation by Jupiter. Cessation of occultations evidently begins some time before the date when the eclipse opens to its maximum width. But the diameters of the orbits of the four inner satellites are smaller; and with them transits and occultations continue. There will be no occultation or transit of Callisto or its shadow this year after January 25th. On this day the shadow was projected on Jupiter between 9 h. 11 m. and 10 h. 5 m. In the plots of the orbits of Jupiter and of the satellites the general directions of the lines of vision from the earth before and after opposition are indicated by arrows.

Obviously the planet does not occupy the same position in its orbit as that shown in the plot before and after opposition. But if this page be rotated clockwise and counter clockwise through small angles, one position will represent Jupiter in his orbit before, and the other that after opposition. Before opposition it is clear that the transit of the satellite's shadow precedes that of the satellite; and after opposition the satellite precedes the shadow. For example: Ganymede's shadow crossed Jupiter's disk on January 7th between the hours of 14 h. 44 m. and 17 h. 31 m. (W. M. T.). The shadow was clear of the planet before the transit of the satellite commenced two hours and twenty minutes later. On June 28th the same satellite will cross Jupiter's disk between the hours 8 h. 56 m. and 11 h. 37 m.; and the shadow will follow 2 hours and 37 minutes later. When a satellite passes into the shadow of its primary, it is described as "eclipsed." The dates of the transits of the satellites and their shadows, and of the eclipses and occultations, are given in the Nautical Almanac for ten months. For one month before and after conjunction (October 18th) when Jupiter's proximity to the sun will be too close for observation, the phenomena of the satellites are omitted.

Relative positions of Callisto, Jupiter and the Earth.



I Plot of Jupiter's orbit.


Orbit of Ganymede
Orbit of Europa
Shadow of Jupiter
Orbit of Io
Orbit of Callisto
Direction of Vision from Earth before Opposition
Shadow of Satellite
Direction of Vision from Earth after Opposition
Shadow precedes Satellite
Direction of Vision from Earth after Opposition
Satellite precedes Shadow
Direction of Vision from Earth before Opposition

II. Plot of Jupiter's orbit and of his satellites' orbits.

JUPITER AND HIS SATELLITES.

That the controlling devices for a single-phase car equipment need not be more complicated than for a direct-current car, states the Electrical World, will be apparent at once from the fact that any of the methods now used with the latter type of car can be applied immediately to the former without alteration. It it evident that by selecting a suitably low value of trolley E. M. F. the familiar series-parallel arrangement of motors with rheostatic acceleration can be applied to series motors of the single-phase type equally as satisfactorily as to those of the direct-current type. Moreover, with the alternating-current equipment it is possible to substitute reactance coils for the resistance of the rheostats, and thereby eliminate a considerable portion of the energy dissipated as heat in the control circuits during acceleration. In addition, with the single-phase car there can be obtained, conveniently, any desired number of voltages to be impressed upon the motor circuits, and there is thus no necessity for limiting the E. M. F. to a single value, as must be done with direct-current equipments. To this latter fact is attributable the essential difference between the controlling circuits of single-phase and direct-current cars.

Observations of the occultations of Jupiter's satellites provide a valuable means for verifying the velocity of light. As the earth recedes from Jupiter after opposition, an occultation is observed to occur after a longer interval of time than that which would elapse if the planets were separated by a constant distance; and after conjunction, when the earth is approaching Jupiter, the intervals are observed to diminish. Light crosses the earth's orbit in a little less than a thousand seconds $\frac{185{,}800{,}000}{186{,}330}$ = 16 m. 37 s. At the date of opposition this year Jupiter's distance from the earth is 413.8 million miles. Occultation of a satellite at this distance is observed on the earth $\frac{413{,}800{,}000}{186{,}330}$ seconds, or 37 minutes after its occurrence. The points *e* and *f* are respectively the positions of Jupiter and the earth at the same date when the projection on the plane of the ecliptic of the line connecting the planets is parallel to that of March 30th. At the second date, when the earth is at *f*, observation of a phenomenon of Jupiter's satellites occurs later than would be the case if the earth remained at the constant distance (*ge*) from Jupiter; and the difference in time is that represented by the interval *gf*, or $\frac{gf}{AP} \times 997$ seconds.

A comparison of the earth and moon with Jupiter's satellite system is shown in Figs. 1 and 2, which are drawn to the same scale. The moon's distance from the earth does not differ very much from Io's distance from Jupiter. The revolution of the latter is accomplished in 1.77 days; and of the former in 27.32 days. If Io's distance were reduced to correspond with that of the moon from the earth, the period of the satellite would be even shorter than that which is given in the table. The rapid revolutions of the planet's satellites maintains them in their orbits in opposition to the great central force attracting them to Jupiter, whose mass is 318 times that of the earth. In the table the diameters of satellites V, VI, and VII are not given. They are too small for accurate measurement, the diameters ranging from 50 to 100 miles.

JUPITER'S SATELLITES.

Name.	Distance, Miles.	Period, Days.	Diameter, Miles.
V.....	112,500	0.5	
Io..	261,000	1.77	2500
Europa	415,000	3.55	2100
Ganymede..	664,000	7.15	3550
Callisto.....	1,167,000	16.69	2960
VI	7,185,000	258.4	....
VII	7,403,000	265.0	....

Correspondence.

A REMARKABLE PHENOMENON.

To the Editor of the SCIENTIFIC AMERICAN:

I have just read with interest on page 138 of the SCIENTIFIC AMERICAN of the "remarkable phenomenon" observed by Mr. V. J. Laine, in which a rainbow was seen to be disturbed after each peal of thunder. Mr. Laine's explanation, based upon the change of size of the rain-drops, is apparently unwarranted, inasmuch as according to the old and generally accepted optical theory of the rainbow, the angular position of the colors of the bow relative to the direction of the sun and the observer's eye, is independent of the size of the rain-drops.

To the writer the phenomenon is more plausibly explained by recognizing the atmospheric disturbance in the line of sight of the observer due to the thunderbolt. The light, after dispersion by and reflection from the rain-drops, passes through air which is agitated by the concussions following the lightning strokes, and the intense sound waves radiating therefrom. The result is similar to that seen over a hot surface, as a stove or heated field, where the convection currents distort the light rays traversing the overlying air.

While it is true that ordinary sound waves do not affect the density of the air sufficiently to deviate the course of light perceptibly, the violent expansion and contraction accompanying a thunderbolt may produce the result. The peculiar circumstance in the case referred to is that the storm approached from the east, opposite to the sun, so that the lightning discharges, which are generally in the advance portion of the storm cloud, occurred in the vicinity of the observer and between his eye and the apparent position of the rainbow, whereas ordinarily when a rainbow is seen in the east it is after the storm has passed over and the lightning is taking place in the distance beyond.

W. H. HOWARD.

Washington, D. C.

THAT CURIOUS WATER PHENOMENON.

To the Editor of the SCIENTIFIC AMERICAN:

I observed a similar curious phenomenon to that reported by James S. Lee in your issue of January 29th. Mine was observed from a train going west through the great Alkali Desert in Nevada. The desert floor is of sand, and flat, as though laid by water. Innumerable desert or beach grass mounds covered perhaps ten per cent of all the surface. These mounds or dunes vary from six to twenty feet in diameter by one to two feet high.

It was about five o'clock of a warm September afternoon. I noticed, looking westward and nearby, what seemed to be a small but powerful stream of water or fountain, going to perhaps twenty-five feet in height. Close observation revealed many hundreds of these fountains. As near as I could make out, there was one from the center of each of the sand dunes, varying in size much as the sand dunes varied in area. These fountains were really formed by incipient cyclones carrying sand, not water, in small streams, somewhat in the shape of slender long-waisted hour-glasses, spreading at the top to fall to earth. These varied from twenty to fifty feet high. The train was making the usual rather slow desert time, which gave a fair chance for observation. This continued for ten miles along the line. What caused them? I suppose the floor of the desert was several degrees cooler than the sand dunes, which had been absorbing solar heat rapidly all day. As evening approached, the warmer air over the dunes rose rapidly, assuming the natural spiral motion, licked up warm dry sand, and made a most beautiful picture. The passengers gazed and wondered why.

Will the Editor please give the correct cause if mine, as given, is incorrect?

San Francisco, Cal. ROY T. KIMBALL.

WANTED: AN ELECTRICAL APPARATUS FOR LOCATING SUNKEN TREASURE.

To the Editor of the SCIENTIFIC AMERICAN:

I have been unsuccessful in finding in England any manufacturer of an improvement upon the underwater electrical ore-finding apparatus originally described in the SUPPLEMENT of your paper dated January 20th, 1906.

I am attempting to locate the position of the hull of a wooden ship about 120 feet long by 40 feet beam, which has on board forty-four cannon and a considerable quantity of cannon ball, aggregating approximately about 20 tons in weight. The ship is also believed to contain a number of silver and copper coins. The hull is covered by about 30 feet of sand and mud, and she lies in about 70 feet of water, in an extremely sheltered bay. Her position is known to within 100 yards. As the vessel belonged to the Spanish Armada, she possesses considerable historical interest. I desire to get into communication with some one who would be able to construct any improvements upon the instrument described in your SUPPLEMENT of the above-mentioned date, and who would give a preliminary test of the apparatus, to show that it could fulfill the working conditions necessary. I would also like to know the cost of the instrument.

KENNETH MACKENZIE FOSS, Lieutenant Colonel.

London, S. W.

The Wisps of Saturn.

In a recent bulletin, Prof. Percival Lowell of Flagstaff, Ariz., announces that on September 19th, 1909, in examining Saturn he noticed what seemed to be faint lacings traversing diagonally the planet's equatorial belt. Not only was the phenomenon unprecedented, but it was so faint and illusive that he was unable at first to assure himself of its objective reality. On mentioning his impressions to his assistant, Mr. E. C. Slipher, he found to his surprise that he had had suspicion of the same thing on September 9th, and had even thought to detect traces of it on the photographs of Saturn taken by him afterward on that day. At the same time that Lowell divined rather than described the wisps he saw unmistakably a fine dark irregular line running longitudinally through the middle of the bright equatorial belt, a line not of uniform character, but as if composed of beads strung upon a wire.

Following up the eye-hint thus vouchsafed he examined the equatorial belt for the wisps at moments of good definition during the succeeding days. Repeated observation of them, both by him and his assistant, eventually showed them to be facts, and then, to clinch the matter, he succeeded in getting, on November 4th, some excellent photographs of the planet in which they stood recorded, appearing *in situ* in successive images on the same plate.

The manner in which the photographs are taken enables ones to eliminate on the images imperfections due the apparatus from features due the planet itself; for not only is the plate moved first horizontally and then vertically for the successive images, but the color-screen through which the photographing is done is itself shifted at intervals during the taking of the plate. Nothing due to either cause could, therefore, perpetuate itself *in situ* on images of the set some distance apart.

On the photographic plate the images appear exactly as they do to the eye, though of course not so well defined, to wit: as wisps or filaments, fainter than the dark belts of the planet's disk, crossing the bright equatorial belt. Like all astronomic phenomena previously unperceived, they became much easier to catch after their presence was known; their recognition not being nearly so difficult as their discovery. Their apparent lack of contrast with their surroundings is for much in this; which is also why the photographs which intensify contrast brought them out.

In look the lacings resemble faint shreds of some dusky substance in the act of dropping from points on one edge of the bright belt over to the other. Though darker than the bright belt, they are much lighter than the dark belts from which they come, a difference in tone which is probably due to their real slenderness being spread out by the light-waves and so thinned in strength.

Careful scrutiny revealed that the wisps started from triangular spots in the dark belt, and Mr. G. R. Agassiz, who was observing with Prof. Lowell, detected that the adjacent parts of this belt were themselves crisscrossed by darker lines. The triangular spots are not difficult, giving the edge of the belt in good seeing a notched or toothed appearance. It has not been possible as yet to use the wisps for timing the rotation periods of Saturn's equatorial region, owing chiefly to their number and the confusion consequent upon it, but identification will undoubtedly come in time and give us a more accurate value of the equatorial speed than we at present possess.

Interesting as the lacings are in themselves, they become doubly so from this fact, that they almost precisely parallel the phenomena recently discovered on Jupiter, in the same regions. Except for faintness, which Saturn's greater distance both from the sun and from us alone would cause, the one set of features is almost a replica of the other. Like the Jovian, the wisps seem to be more tenuous in the middle of their course. Like the Jovian equatorial phenomena, too, the medial core is more conspicuous than the wisps.

The Saturnian lacings cross the equatorial belt usually at an angle, but one which is less than that of the average of the Jovian ones. This angle should have something to say about the factors concerned in the formation of the two sets respectively; for analogy is best explained by secondary difference.

Official Meteorological Summary, New York, N. Y., February, 1910.

Atmospheric pressure: Highest, 30.73; lowest, 29.43; mean, 30.12. Temperature: Highest, 59; date, 28th; lowest, 2; date, 7th; mean of warmest day, 54; date, 28th; coolest day, 11; date, 7th; mean of maximum for the month, 37.6; mean of minimum, 25.1; absolute mean, 31.4; normal, 30.7; daily excess compared with the mean of 40 years, 0.7. Warmest mean temperature of February, 40, in 1890; coldest mean, 23, in 1875-1885. Absolute maximum and minimum of February for 40 years, 69 and — 6. Average daily excess since January 1st, 1.3. Precipitation: 4.07; greatest, 1.57; date, 28th; average for February for 40 years, 3.80. Accumulated excess since January 1st, 2.08. Greatest precipitation, 7.81, in 1893; least, 0.82, in 1895. Wind: Prevailing direction, West; total movement, 9,679 miles; average hourly velocity, 14.4; maximum velocity, 45 miles per hour. Weather: Clear days, 8; partly cloudy, 10; cloudy, 10; on which 0.01 or more of precipitation occurred, 9. Snowfall, 5.3. Mean relative humidity, 65.5. Sleet, 9th, 12th. Dense fog, 21st. Mean temperature for the winter, 31.73; normal, 31.80; deficiency, 0.07. Precipitation for the winter, 14.68; normal, 11.03. Excess, 3.65. Total snowfall for the winter, 33.3.

Ephemeris of Comet A 1910.

A letter has been received at Harvard from Capt. T. E. De Witt Veeder, Superintendent U. S. Naval Observatory, giving the following elliptic elements and ephemeris of Comet A 1910, computed by Prof. H. R. Morgan:

"Numerous direct solutions having failed, the distances for Washington observations January 25th and February 4th were varied to get the following elements. A slight change in the elements carries the comet near Mercury January 19th, and near Mars last year."

ELEMENTS.

Epoch = 1910, January 20.5d. Gr. M. T.
M = mean anomaly at epoch = 7° 46′
ϖ = longitude of perihelion = 135° 20′
Ω = longitude of node = 88° 16′ } Ecliptic 1910.0
i = inclination = 137° 9′ }
φ = angle of eccentricity = 66° 15′
Log. a = log. mean distance = 0.1560
Log. μ = log. mean daily motion = 3.3116

(O-C.)

	Jan. 16.	Feb. 2.	Feb. 10.
Δ n	−8.0m	+2.1m	+0.6m
Δ β	−3.1m	+6.2m	−4.2m

EPHEMERIS.

Gr. M. T.		H.	M.	S.	δ		Log. Δ	Log. n
1910. February	26.0d.	22	12	45	+ 1.2°	9″	0.2890	0.0239
March	2.0d..... ..	22	16	16	13.	4″		
March	6.0d.....	22	19	21	13	55′		
March	10.0d...	22	23	35	+14.	45′	0.3107	0.0963

The Current Supplement.

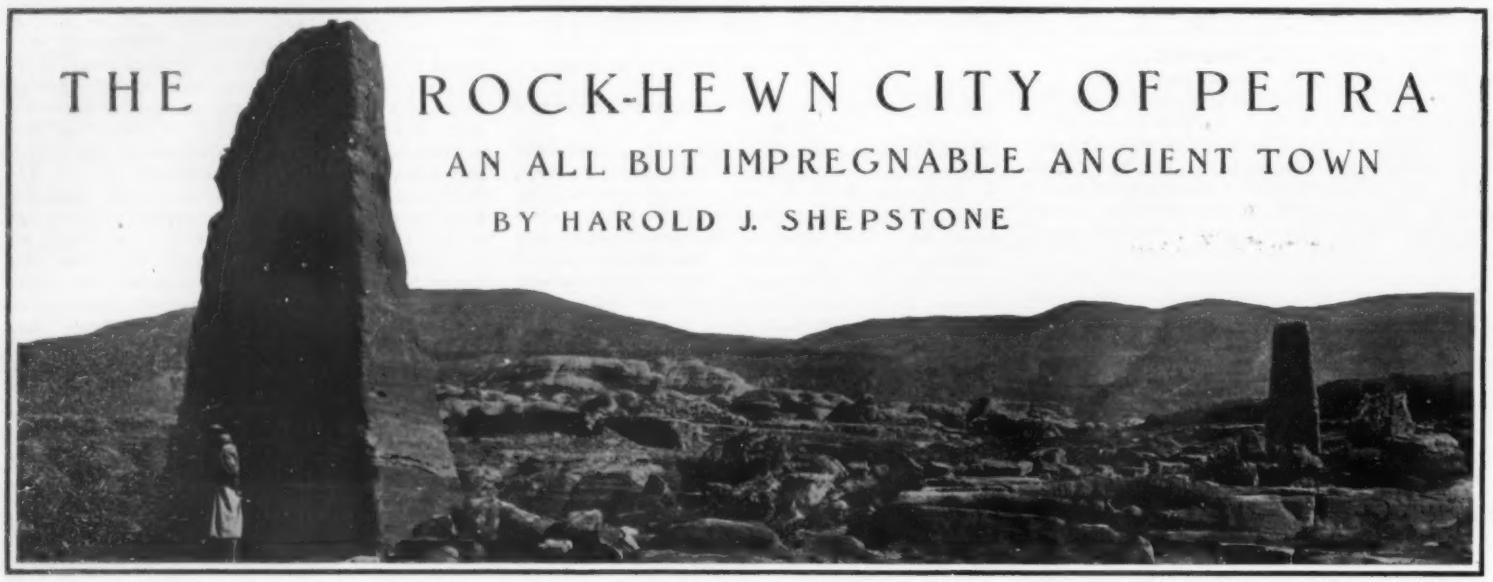
A new process for reducing atmospheric nitrogen, invented by Dr. Schönherr, is described in the opening article of the current SUPPLEMENT, No. 1784. Among the present wonders of science, none stirs the imagination so powerfully as the doctrine that some forms of insanity are the result of a chemical change in the blood. The theory is elaborately discussed in an article entitled, "The Chemistry of Insanity." The recent development of aeronautics has suddenly created a demand for large quantities of hydrogen at a low price. The subject is considered in a short article. Emil Kosack writes an article on speaking magnets, speaking iron, and speaking wire. Since the experimental bombardment of the "Belle Isle" of the British navy, no such thorough and systematic firing tests have been directed against a warship in any foreign navy as those of which the French warship "Jena" was the subject last year. An elaborate article by a competent authority gives the results of the tests. W. P. Dreaper exhaustively reviews the artificial silk industry. One of the most recent important events in the field of prehistoric archæology was the discovery of a megalithic monument of remarkable size in Bisceglie, Italy. This subject is discussed in an illustrated article. In the middle ages falconry, or hawking, was regarded as the king of sports, as it was the sport of kings. The origin and development of this obsolete form of hunting is discussed by Dr. Hans Bollmer in an article entitled "Falconry in the Middle Ages." Perhaps the most distinguished authority on the subject of precious stones in Germany is Prof. M. Bauer of Marburg. He contributes an exhaustive article on artificial stones, which contains a wealth of technical information. The process of directly producing ammonia from coke-oven gas is described. Since Davy, nearly a century ago, constructed the first safety lamp, inventors almost innumerable have produced lamps bearing their names, but in the majority of instances the alleged improvements have been more apparent than real. A comparative estimate of the safety of these various forms of miners' lamps is presented by J. B. Marsaut. F. W. Henkel contributes an article on astronomy and astrology, in which he riddles the supposed influence of the planets upon human affairs.

After three successful flights on March 2nd, Lieut. B. D. Foulois, in a Wright aeroplane, made a fourth attempt at San Antonio, which resulted disastrously. The rudder of the machine was wrecked, and Lieut. Foulois had a narrow escape from injury. The machine had just turned the southern end of the parade field at Fort Sam Houston when the engine stopped. The aeroplane fell forty feet to the ground.

THE ROCK-HEWN CITY OF PETRA

AN ALL BUT IMPREGNABLE ANCIENT TOWN

BY HAROLD J. SHEPSTONE



The rock-hewn obelisks of Petra.

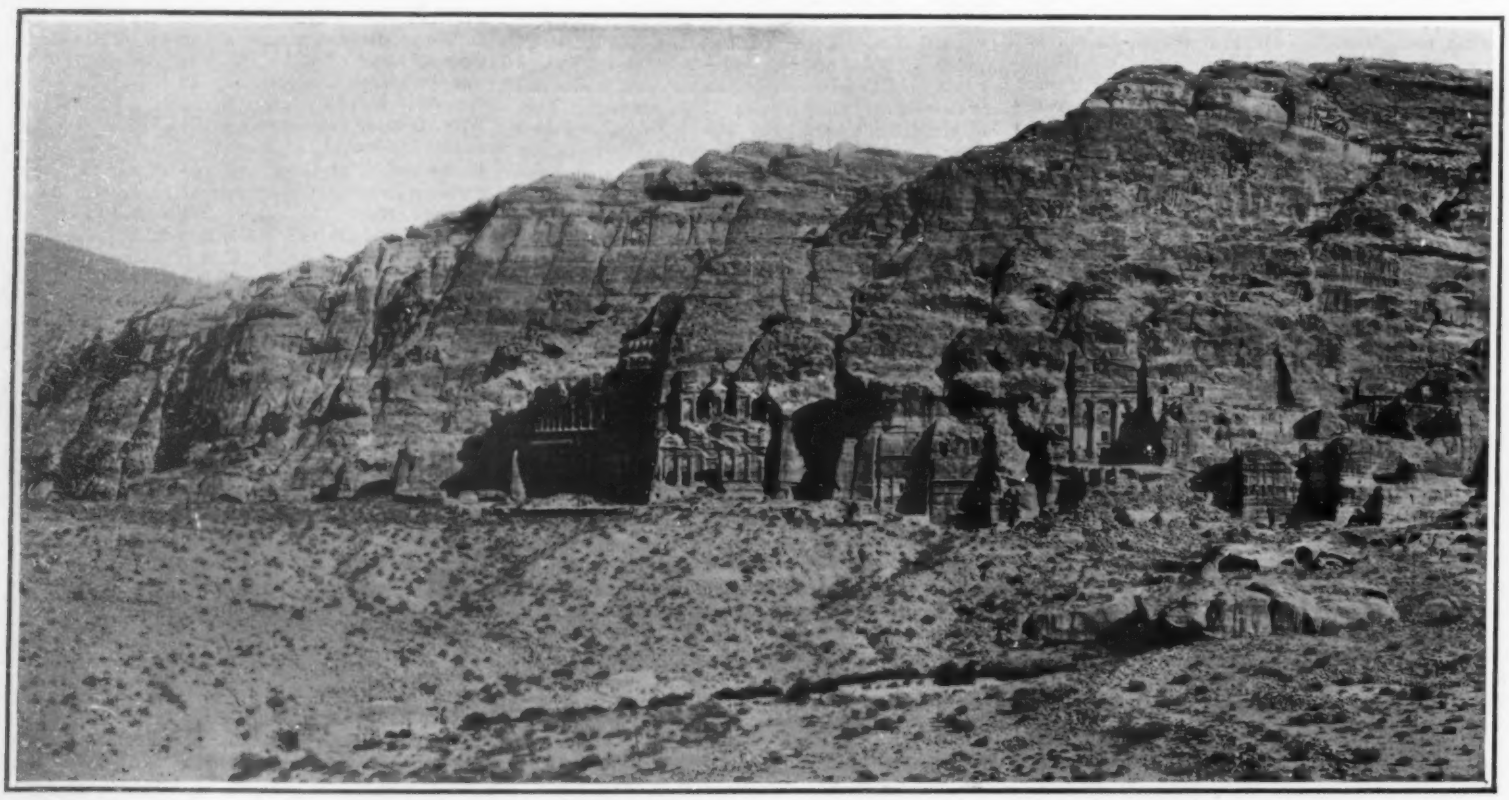
The view is taken high up to the south of the narrow valley called the Wady Mousa (the Vale of Moses) in which the famous rock-cut city of Petra reposed in ancient times, securely shut in from attack of the marauding desert tribes. It is on what bears the name of the Mountain of Obelisks, so called from the huge monolith pillars that have been made with incredible toil by cutting away from all around them the mountain top. Their height can be judged by comparison with the figure of a Bedouin standing by one of them. They are evidently Egyptian in their conception and design, as also are many of the pylons and temples of Petra.

Unique among the many wonders of the Orient and the remains of hoary civilizations stands Petra, the rock-hewn city, the city so graphically addressed by the prophet as 'Thou that dwellest in the clefts of the rock, whose habitation is high" (Obad. 3), and referred to in the challenge of the Psalmist (60:9): "Who will bring me into the strong city? Who will lead me into Edom?" It lies on the northwest edge of the great Arabian desert, about midway between the Gulf of Akabah and the Dead Sea. Other ruins, such as Palmyra and Baalbec, show crumbling piles of magnificent architectural monuments, but in Petra, high up among the mountain crags that sentinel it, are temples, theaters, tombs, and other structures, strong and indestructible, standing almost as perfect as when they were chiseled out of the living rock of which they still form a part.

These ruins (if ruins they may be called) challenge admiration by the variety of styles they embody, showing, in the most ancient creations, early native art intermixed with Egyptian, and in the later magnificent edifices the best types of Greek and Roman architecture; and by the exquisite hues of the sandstone from which they were hewn, varying from the prevailing purplish-red of the mountains and cliffs to the delicate pink and rose color of some strata, and the white, crimson, yellow, and blue-ribboned veins in other places, rivaling the softness of the plumage of birds or the petals of flowers.

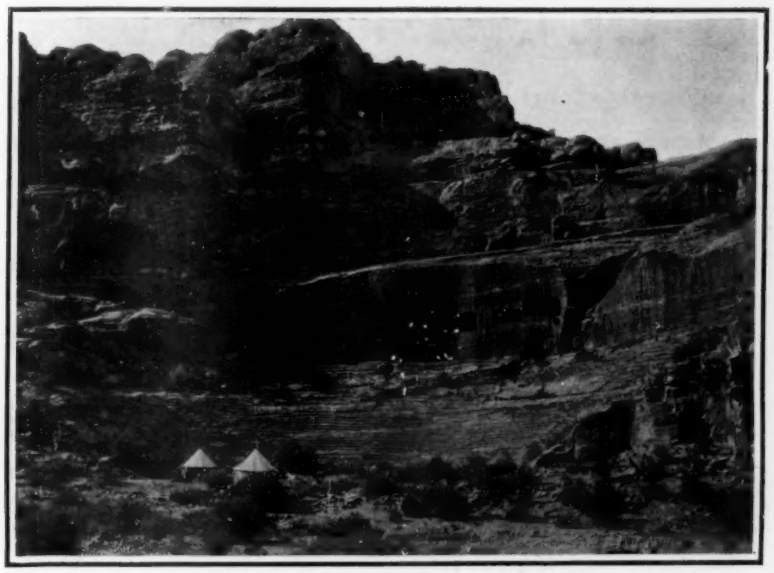
Petra, so long inaccessible because of its remoteness and the danger from roving Bedouins, may now be reached by a six hours' ride westward toward the Arabah from El Maan, a station on the new Mecca railroad. Prof. Gustaf Dalman, director of the German Archeological School of Jerusalem and the author of a monumental work on Petra, has just paid another visit to this scene of his former explorations, in which he was accompanied by photographers of the American colony in Jerusalem, who secured a number of photographs of these majestic ruins, some of the most striking of which we here reproduce for our readers.

Petra, nestling amid its precipices and cliffs almost in the shadow of Mount Hor, called by the natives Jebel Harun (Aaron) from the tradition that it was here on the top of the mount that Aaron died, is approachable only from the east through a deep and narrow defile which the little stream of the Wady Musa has in past ages cut for itself in the red sandstone. The gorge opens in one place to about two miles in width for a distance of about a mile, and here, protected by mountains and precipices on every side, this remarkable town lay secure from attack from without. It was its impregnable position and its being on the great caravan route to the Red Sea from the north that gave it the importance it had as a trade depot and stopping place. The approach was beneath a grand arched portal at the mouth of the Sik (as the deep ravine is called), some remains of the portal being still visible. It takes half an hour to follow the windings of the narrow path along the dark ravine, which is only from 10 to 20 feet wide, threading the course of the oleander-fringed stream bed until one emerges into the small open valley. The variegated sandstone rocks rise precipitately on either side to the height of from 100 to 165 feet, almost shutting out the light of day. One of our views shows the entrance to the Sik. Another is taken about twenty minutes in from the opening, giving a good idea of the narrowness of the defile and the precipitousness of the rock walls, while beyond, where the gorge widens a little, are seen the sculptured columns of the magnificent so-called Khaznet el Farioun (the Treasury of Pharaoh), although it is one of the latest of the rock-hewn monuments of Petra, being attributed to the Emperor Hadrian, who visited the place in A.D. 131 and erected here a temple to Isis. Another of our photographs shows this imposing structure, which is justly regarded as one of the wonders of the East. The rock wall from which it is hewn is here an exquisite rose pink. It is in a state of remarkable preservation. The imposing façade shows two rows each of six majestic columns, one row above the other, with niches in which are rock-



This is a general view of Petra, a city of antiquity carved out of the living rock. The entrance to the Rock City is the most striking gateway to any city on our planet. It is a narrow rift or defile, bisecting a mountain of many-hued sandstone, winding through the rock as though it were the most plastic of clay. This Sik, or defile, is nearly two miles long. Carved with matchless skill, after the conception of some master mind; gathering the beauties of the stream, the peerless hues of the sandstone, the towering cliffs, the impassable ravine, the brilliant atmosphere, and the fragment of blue sky above, the city stands unique

PETRA: AN ANCIENT CITY CARVED OUT OF A MOUNTAIN OF SANDSTONE AND ENTERED BY A MYSTERIOUS RIFT TWO MILES LONG.



The theater among the rock-cut ruins of Petra.

Ed Der, one of the most remarkable of the temples and tombs of Petra.

hewn equestrian and other statues, the whole terminating above in a miniature temple crowned by a huge urn, the entire height being about 65 feet. Within is a bare lofty room and some chambers.

A short distance beyond one emerges into the mountain-guarded valley in which the city lay, mounds of debris marking the sites of the former homes of the Petrans, the population in the city's palmy days being estimated at from forty to eighty thousand souls. The rock-hewn structures chiseled in the precipitous cliffs on every side were public buildings and tombs rather than dwellings. Just on the left, as the valley is entered, is the vast rock-cut theater in semicircular form, capable of holding 3,000 spectators. Here the workmanship is Greek. There are thirty-three tiers of seats. In this locality are some of the oldest tombs, including detached pylons. Many of the oldest tombs were cut away when the theater was hewn out of the mountain side. One of our photographs is of the theater.

Standing in this small open valley one sees the façades of tombs and temples of many styles and dimensions, with many niches for votive offerings. They are at all elevations, many low down on the mountain side, and others high up in the cliffs, with stairways cut in the rock to reach them. While most of them stand out conspicuously, others are hidden in the mountain recesses and lateral valleys. How eloquent are these silent pylons and obelisks of Edom and Egypt, and these columns and capitals of Greece and Rome! What diverse peoples these tombs have looked down upon when living and given sepulture to when dead! And how many different religions have been represented by ministering priests at these shrines!

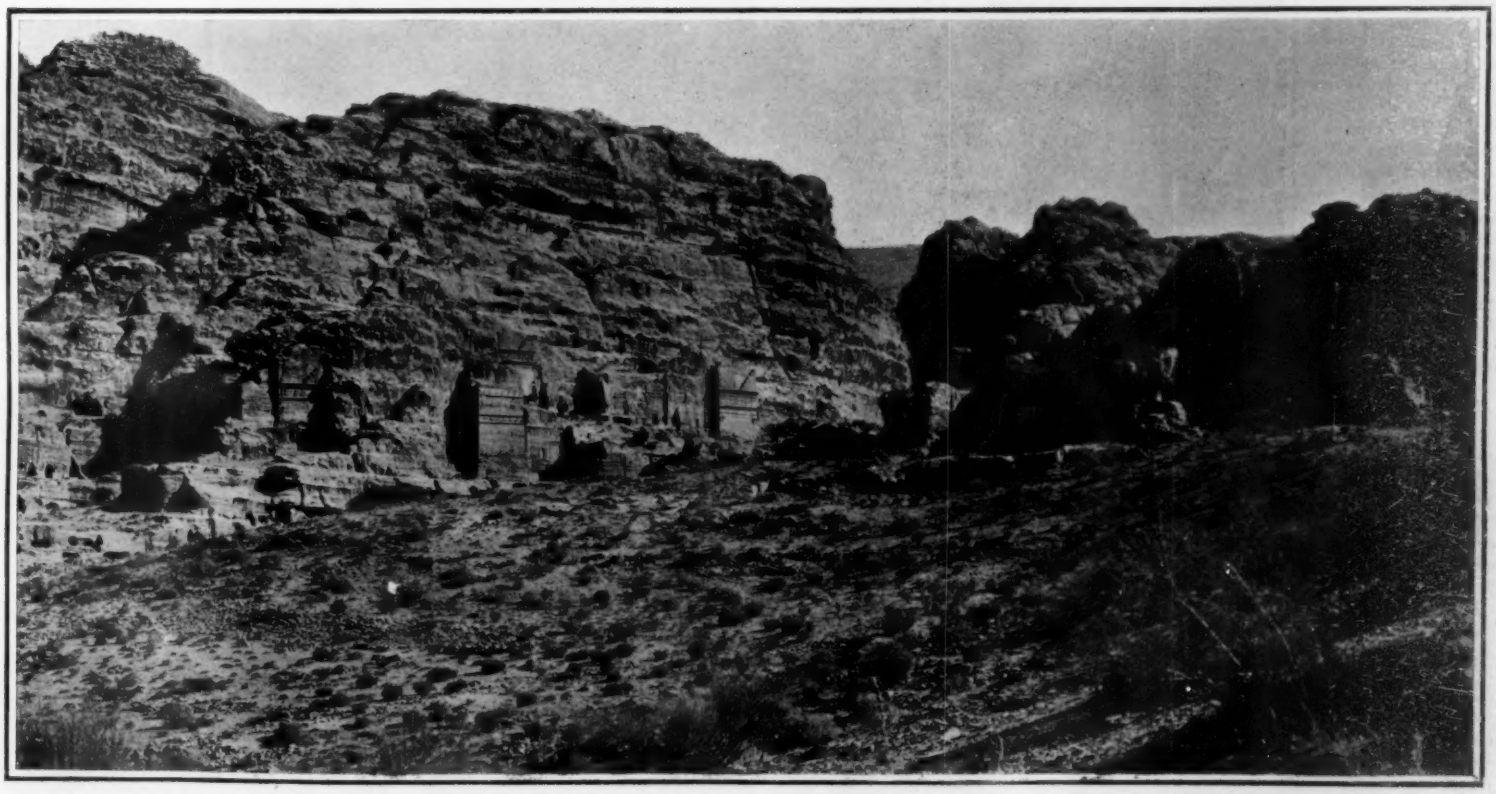
The Sik, the entrance to Petra, the impregnable rock-hewn city of antiquity.

One of our photographs is of a tomb or temple in three stories cut out of the mountain wall on the east, and showing a succession of similar buildings beyond. The façade of this tomb is not, like most of the others, in imitation of a temple, but of a lordly palace, and it has been considerably damaged.

On the opposite side of the valley to the west stand the remains of a masonry edifice called by the natives Kasr Farioun (the Castle of Pharaoh), of which we also give a photograph. It was a Roman heathen temple.

Behind the Kasr Farioun, a rock-cut staircase leads up the rugged hill of the Acropolis to the Place of Sacrifice, with its altars, pool, and court, all hewn out of the living rock. This was a typical holy place, or "high place," of the primitive

(*Concluded on page 227.*)



among the ruins of antiquity. Gaze at the stupendous walls of rock which encircle this ancient habitation, and mark how man himself, but an imitator of Nature, has adorned the winding bases of these encircling walls with all the beauty of architecture and art—with temple, tomb, and palace, column, portico, and pediment—while the mountain summits present Nature in her wildest and most savage forms, and among the ineffaceable impressions of your soul will be the memories of this silent, beautiful, "rose-red city half as old as time."

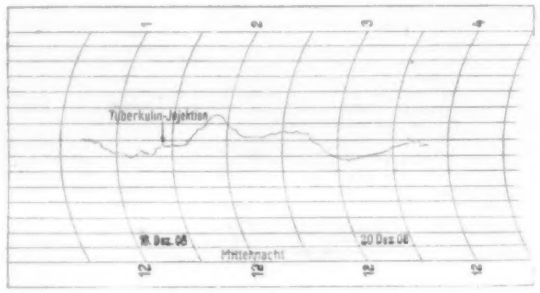
PETRA: AN ANCIENT CITY CARVED OUT OF A MOUNTAIN OF SANDSTONE AND ENTERED BY A MYSTERIOUS RIFT TWO MILES LONG.

AN ELECTRICAL FEVER RECORDER

BY DR. ALFRED GRADENWITZ

Fever, i. e., the rise in blood temperature attending certain maladies, is known to be the outcome of a spontaneous reaction on the part of the body against the microbes invading it. The opinion is, therefore, erroneous that fever in all cases should be acted against in order thus to subdue the morbid state of the patient. Nevertheless, it is of the highest importance that the physician be kept informed of the variable temperature of the blood.

According to present practice, temperature readings are taken at regular intervals, say three or four times a day, by a sensitive thermometer. This practice obviously gives no information as to those oscillations in temperature which may have occurred in the meantime, and which, in some cases, it would be desirable to know. A process allowing this important factor to be recorded continually and automatically, therefore, is worthy of universal attention. A firm of Berlin constructors, Messrs. Siemens & Halske, have recently perfected an apparatus achieving this result.



Record obtained with fever recorder, showing effect of tuberculin ignition.

The apparatus is based on a very simple principle, viz., the alteration in the electrical resistance of platinum wire by variations in temperature. It comprises, in addition to a coil of platinum wire, a Wheatstone bridge and a self-recording millivoltmeter.

The platinum coil is either introduced into some of the cavities of the body or fixed on the body. A double conductor of low resistance connects the coil with the bridge and millivoltmeter, which records any variations in the resistance of the platinum wire, and accordingly the temperature of the body.

The current required to feed the apparatus is supplied by a small storage battery of four volts, the gradual drop in tension being compensated for in a simple manner by means of a testing and regulating resistance, with coarse and fine adjustment. As the normal range of the recording apparatus comprises the interval between 30 deg. and 45 deg. C., the curves registered are of sufficient distinctness for any therapeutical and scientific purpose.

The electrical fever recorder is constructed in two different types:

In the first type, the rotating coil of the millivoltmeter is suspended from a strip of metal, the curve being recorded on a paper tape about 45 meters in length, which is moved along by a clockwork at a speed of 20 millimeters per hour. The useful width of the tape is 120 millimeters. Below the paper tape there moves under the action of a clockwork, an inking ribbon, over which oscillates a pointer carrying at its end a runner. The position of the pointer is marked by a dot each minute. The series of points thus produced forms a distinct curve. The clockwork should be wound up once a week, a new paper roll being inserted every three months.

The second type comprises a rotary coil located between points, so that the apparatus is insensitive to any moderate oscillations while not requiring accurate horizontal adjustment. The registering tape is wound together with a sheet of carbon paper round a drum. As in the former apparatus, a style marks time. The apparatus is designed either for a rotation of the drum (about 360 millimeters in periphery) in about 7 days, or in 24 hours. The paper tape and carbon should be exchanged after each turn, which is a very easy matter. The dropping of the bow occurs in accordance with the rotation speed of the drum, and takes place either every 12 or every 2 minutes. In order to allow for both speeds, the apparatus can be fitted with two drums, exchanged against each other by a simple manipulation. The useful width of the paper tape in this case is about 80 millimeters, i. e., somewhat less than in connection with the former type. This is why the one is generally used for accurate, scientific investigations and the latter for ordinary clinical apparatus.

AN ELECTRICAL DEVICE WHICH RECORDS A PATIENT'S TEMPERATURE FOR EVERY MINUTE OF THE DAY AND NIGHT.

Treasure Hunting.

BY GEORGE ETHELBERT WALSH.

The United States Hydrographic Bureau and Coast Survey has charts of the Great Lakes and the Atlantic and Pacific coasts which are consulted eagerly by a large class of adventurers and hard, practical men of business and science, who are interested in the recovery of lost wealth through improved methods of deep-sea diving and wrecking. These charts are simple and unimpressive in appearance, and might easily be mistaken for ordinary coast charts with here and there dots to represent submerged reefs or rocks, but to the initiated they tell a whole history of romance and adventure, stories of shipwreck and disaster, tales of lost treasures and of strenuous efforts to recover them. The charts locate the position of sunken wrecks in water so deep that no divers or wreckers have yet succeeded in raising them or unloading from their hulks the wealth of treasures known to exist in them. Some of these wrecks carried down with them gold and silver bullion, which time and salt water cannot destroy, and others are laden with ores of great value, but not so generally prized by the treasure seeker. On the Great Lakes alone the exact positions of wrecks are charted which contain many millions of dollars in bullion and ore. There is no vague uncertainty about these treasures. They were known to exist in the holds of the ships, and no man has yet been able to recover them. The steamer "Pewabic," for instance, which went down in Lake Huron in a storm in 1865, carried with her half a million dollars' worth of copper from the Lake Superior mines. For three decades expeditions sought to find the wreck, and finally it was located about six miles southeast of Thunder Bay. But the wreck was in such deep water that only a very small fraction of her cargo was ever recovered. Here is a submarine copper mine which might tempt the most adventurous soul to risk his life in gaining.

The chart of wrecks on the Great Lakes compiled by the Hydrographic Bureau and Coast Survey shows the relative depth of water, and this simple record tells the whole story of why enterprising man has not been able to recover them. Divers seeking treasures in sunken vessels have learned that anything which lies much more than 100 feet deep is very difficult, if not absolutely impossible, to recover. The pressure of the water beyond that depth becomes so great that diving suits are apt to collapse and crush the wearer. We know from a study of the charts that hundreds of ships loaded with treasures have sunk in water ranging from 100 to 250 feet in depth, and if diving suits could be invented to withstand the enormous water pressure at the lowest depth, and enable the diver to work easily, enormous fortunes could be quickly made.

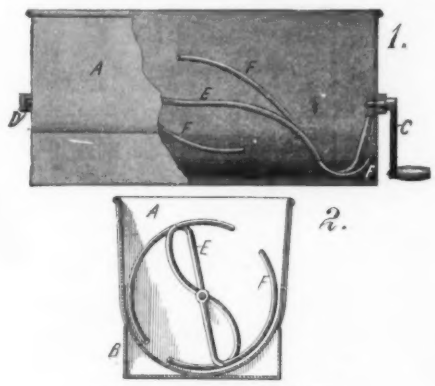
The whole history of treasure hunting under the water has been marked by man's futile effort to fight against the pressure at great depths. One hundred feet below the surface of the sea, the pressure is about fifty pounds to the square inch. The ordinary diving suit of rubber is inflated by compressed air, which is regulated to the depth reached. Below one hundred feet the diving suit itself frequently collapses. There have been many fatal accidents in attempting to work below the 100-foot mark. For instance, when the steamer "Pewabic" was located in Lake Huron, a diver from Toledo, Ohio, went down to inspect it, and was hauled up dead. The steamer was in a depth of water approximating 200 feet. Two other divers in the next few years met the same fate. In 1892 Oliver Pelky,

(Continued on page 227.)

Patent Department

DOUGH-MIXING APPARATUS.

Pictured in the accompanying engraving is a device adapted more particularly for kneading dough, but which is also applicable for mixing, stirring, or churning any material for household or culinary



DOUGH-MIXING APPARATUS.

purposes. The machine comprises an approximately rectangular receptacle *A* formed, however, with a curved bottom, and an outer casing *B*, which acts as a support for the receptacle. The end walls of this mixing machine are provided with journal bearings, in one of which a crank handle *C* is supported. The other journal consists of a socket *D*, adapted to receive one end of a spirally curved stirrer blade *E*. The opposite end of the stirrer blade is formed with a threaded hub into which an extension of the crank handle axis is screwed. Secured to the stirrer blade at each end are a pair of outwardly projecting arms or curved fingers *F*, the object of which is to reach the material that is not properly stirred and mixed by the main stirrer blade. In use as the crank handle is turned, the fingers tend to feed the material toward the center, so that it is fully acted upon by the main blade. We are informed that in practice this type of stirrer kneads and mixes the dough thoroughly and evenly in a comparatively short time. By holding the stirrer blade and turning the crank in a reverse direction, the latter will be unscrewed from the hub, so that both the crank and the stirrer blade may be removed from the receptacle. A patent on this mixing mechanism has been granted to Mr. Sanner E. Ray of McConnellsburg, Pa.

IMPROVED STEP LADDER.

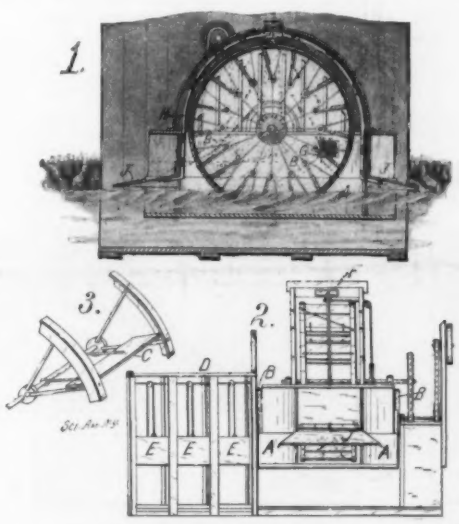
In the SCIENTIFIC AMERICAN of November 14h, 1908, we published a description of a collapsible step ladder. An improvement upon this form of ladder has recently been patented, which is provided with an upper section that may be removed and replaced with a shorter section, thus reducing the height of the ladder. As shown in the accompanying engraving, the ladder consists of the lower side-rails *A*, connected by means of sleeves with the upper side-rails *B*. The ladder is collapsed by swinging one side against the other, but normally the rails are held apart by means of a diagonal brace, such as shown on the lower section of the ladder. The steps *C* of the ladder are hinged to one of the side-rails as shown in Fig. 3, while at the opposite side they are provided

IMPROVED STEP LADDER.

with brackets *D*, in which are slots adapted to engage hinge pins secured in the side-rails *A*. This slot and pin connection provides the necessary play when the ladder is collapsed. The pins on which the steps are hinged lie at right angles to the rails *A*, and in order that the tread surface may be horizontal, the steps are made of a substantially wedge shape, as indicated in the illustrations. The top or platform *E* of the ladder is also hinged to the rails at the points *FF*, which lie on an axis at right angles to the rails *B*. To support the ladder in its normal inclined position, two legs *G* are provided. The legs are connected by the usual links *H* to the rails *A*, and at the upper ends they have extension pieces that are hinged to the rails *B*. When it is desired to shorten the ladder, these extension pieces with the upper rails *B* are withdrawn from their sockets. Then a top piece, such as indicated in Fig. 2, is applied to the ladder, the four short legs of this piece being inserted in the sleeves at the upper ends of the rails *A*. The legs *G* are now made fast to the rails *A* by means of pins *J*, which pass through them and also through the legs of the top piece. To prevent the legs *G* from spreading too far, they are retained by means of brace bars *K*. The links *H* in this case are unnecessary and are folded upon themselves, as indicated in Fig. 2. Mr. William J. Blundell, Box 182, Brooklyn, N. Y., is the inventor of this improved step ladder.

NOVEL CURRENT WHEEL.

A number of advantages are claimed for the wheel illustrated herewith, namely, that it does not require the use of dams, it regulates itself to the rise and fall of the stream, uses only the surface current, is equipped with feathering blades, and is provided with means for preventing the parts from freezing fast in cold weather. The water wheel is supported on pontoons, as indicated at *A* in the illustration.

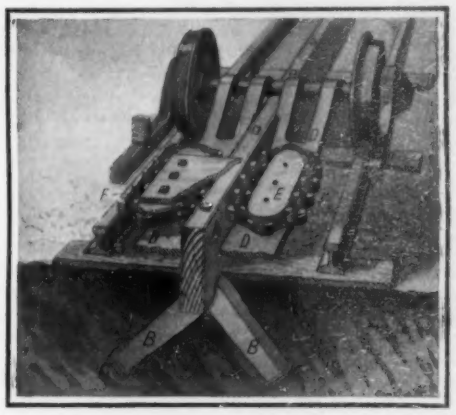


NOVEL CURRENT WHEEL.

The pontoons are connected by means of links or parallel arms *B* to a fixed framework supported on piles driven into the bed of the stream. Fig. 3 shows the construction of the blades used on the wheel. The spokes of the wheel are arranged in two parallel sets, which are bifurcated at their outer ends. The blades *C* are hinged to rods connecting the parallel spokes, and have free play in the bifurcated portions. This provides a very strong construction, and enables the blades to accommodate themselves to the current, so that there is no lifting of the water, as in an ordinary water wheel. It will be evident that as the water rises and falls, the wheel will rise and fall with it, so that the blades will always extend to a uniform depth into the water. However, when the water rises, the surface current is apt to be very swift, and it is necessary to reduce the flow past the wheel. This is effected as follows: On the up-stream side of the structure a wing *D* (Fig. 2) is built out diagonally into the stream, so as to direct a large portion of the current between the pontoons and against the water wheel. In this wing are a number of flood gates *E*, connected by means of ropes and pulleys to one of the pontoons *A* in such a way that as the water rises, the gates will open, permitting the water to flow through them, and thus cutting down the current that strikes the wheel. To protect the parts in cold weather, a casing is built over the wheel, at the top of which is a suction fan *F*. This is belted to the wheel as shown in Fig. 2. Through a duct *G* a current of warm air is conducted to the interior of the casing, and thence is sucked out of the top of the casing by means of the fan and delivered through the pipe *H*, as indicated by the arrow. At the up- and down-stream sides of the casing, hoods *J* are placed, which come close to the surface of the water, and prevent the fan from drawing in cold air instead of the air through the duct *G*. The inventor of this improved water wheel is Mr. W. P. Spooner, Box 3 "The Manse," Carievale, Saskatchewan, Canada.

CAR-RETAINING DEVICE FOR RAILWAY CURVES.

In order to insure the safety of cars when rounding curves, and to prevent the car wheel flanges from having undue frictional engagement with the rails, a safety mechanism has recently been invented, which is pictured in the accompanying engraving. It consists of a central rail *A*, that is supported on the ties

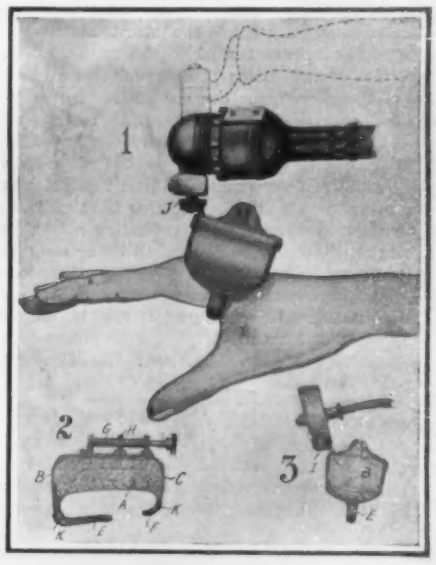


METHOD OF RETAINING CARS AT CURVES.

and is strongly braced by means of anchoring devices *B*, which are imbedded in the ground and terminate in plates *C*. The object of these plates is to prevent the anchoring devices from working upward. The illustration shows a portion of a car truck passing over the rail *A*. The axles of the truck are connected by means of auxiliary trusses *D*, below the main trusses, on which blocks *E* are supported. Designed to travel around these blocks *E* are endless chains *F*, fitted with rollers. The rollers are pressed by the blocks *E* against the guide rail *A*. As the truck passes round a curve the rollers tend to keep it in place. Ordinarily, the forward wheel on the outside of the curve tends to bear against the rail, owing to the fact that it is rigidly connected with its mate on the other side of the curve, and hence it cannot travel faster than the latter. The result is that the flange on the outer wheel is subjected to considerable wear. The centering device here shown, however, will prevent the flange of the outer wheel from being unduly pressed against the rails. The guide rail serves to prevent spreading of the rails, and keeps the cars from leaving the track. The inventor is Robert Belden, of Pulga, Cal.

MASSAGE APPARATUS.

A patent has recently been granted upon a device for securing a vibrator to the hand for application in the operation of massage. The apparatus may be adjustable, to adapt it for use by different persons, and may be securely clamped to the hand, so as to impart to it the vibratory movement that is used in certain massage treatments. As shown more particularly in Fig. 2, which is a cross section of the device with the vibrator removed, it comprises a padded cushion *A*, provided with two plates *B* and *C*, which terminate in horns *E* and *F* that fit the palm of the hand. These horns may be covered with sleeves *K* of rubber if desired. The plate *C* is formed with two lugs, between which is mounted a screw *G*, and the latter is provided with a knurled thumbpiece, whereby it may be

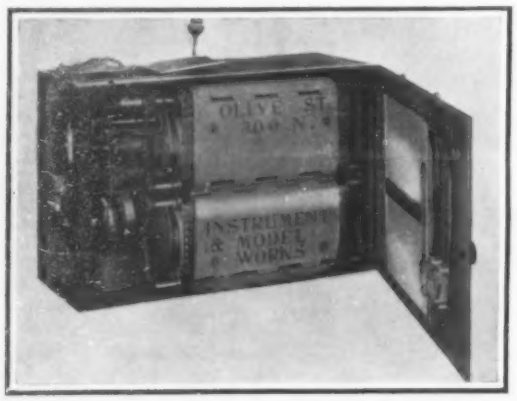


MASSAGE APPARATUS.

turned. The plate *B* is fitted with a nut *H* that engages the screw, and as the screw is turned the plates are relatively adjusted to bring the horns closer or move them farther apart. In this way the device may be clamped on the hand. The cushion *A*, however, renders the device comfortable to the operator. Projecting from the forward end of the device is a bracket *I*, as indicated in Fig. 3, to which the vibrator mechanism is applied. Fig. 1 shows the preferred form of vibrator, which has a threaded stem that engages a socket in the bracket *I*. A locknut *J* serves to make the vibrator fast. This type of vibrator is sometimes equipped with a handle, as indicated by dotted lines, so that it may be used without attaching it to the hand. In such a case, however, various "applicators" are secured to the threaded stem to take the place of the operator's hand. Fig. 3 shows another form of vibrator, which is fastened to the bracket by means of screws. The inventor of this massage apparatus is John Sabatino, Broadway near Spruce, Morris Park, New York.

STREET INDICATOR FOR CARS.

The desirability of having the streets announced by means of a conspicuous sign in a street car has often been urged, but hitherto efforts in this direction have met with little success. Quite recently when a device of this type was about to be adopted on an important city line the objection was raised that it would obstruct and detract from advertisements placed in the cars. This objection is overcome in the apparatus shown in the accompanying engravings, which not only announces the streets, but also displays advertisements at the same time. The inventor hopes that by making the device self-paying as well as a convenience to the public, it will meet with better favor than street indicators heretofore devised. The prominence of an advertisement placed where all eyes would be concentrated upon it should make this a most valuable advertising medium. It is the inventor's idea to use a succession of advertisements so that the display could be changed at each street with the street number. The sign display and street indicator is arranged to be hung at any suitable point



STREET INDICATOR FOR CARS.

in the car and immediately after passing a street the mechanism is actuated to announce the next street and display a fresh advertisement. This change is effected by means of contact plates which are secured to the cross wires supporting the trolley wire. The contact plate engages a spoke of a wheel, causing the latter to make a quarter turn and momentarily close an electric circuit coming from the wire that supplies current to light the car. This momentary impulse actuates a relay in the apparatus contained within the case of the indicator, and by means of a small electric motor the webs on which the street numbers and signs are printed are turned to the required degree. Should one of the plates become detached from the cross wire the conductor can operate the indicator by means of a switch. When the end of the line is reached the mechanism is reversed so that the streets will be announced consecutively in the reverse direction. Should the car cross a different set of streets on the return trip, instead of running the web forward for the whole round and then rewinding at the starting point the web may be arranged to bear the streets of the return trip interspersed with the streets of the forward trip and a shutter may be employed to cover the street names of the first part of the trip, exposing only those of the return trip. The inventor of this street indicator is Mr. H. Alwies, 214 South 11th Street, St. Louis, Mo.

AN AUTOMATIC RAILWAY SAFETY SYSTEM.

It is a comparatively simple matter to develop an absolutely automatic railroad system, in which the engineer will be entirely dispensed with and the trains will run under electrical control from some central controlling station. The reason this has not been done so far, however, is because no entirely automatic engine is as safe as one controlled by an engineer. The railroads have long recognized the fact that what is needed is not a machine to take the place of the engineer, but one which will act as a check upon the engineer without taking the responsibility from his shoulders—a system that will perform the engineer's work in case of any lapse on his part and make a record of this lapse so that the responsibility for failure on the part of the engineer will be detected. A system of this sort was recently installed for purposes of experiment over a short stretch of the Erie Railroad from Newark to South Paterson. The system is quite ingenious in the fact that it gives protection against broken rails as well as collision, and furthermore is provided with telephone connection which enables the engineer to communicate with station houses along the line when the train is brought to a stop for any reason and even while the train is running at full speed. The advantages of this telephone system will be appreciated by passengers, who can use it to communicate with their homes or to conduct business while *en route*, and the train dispatcher is enabled to come into direct touch with the various units along the line which are under his charge. In this system the track is divided into block sections, and the train as it enters each block electrically tests the block ahead to determine whether there is any obstruction on the rails or whether the rails are broken.

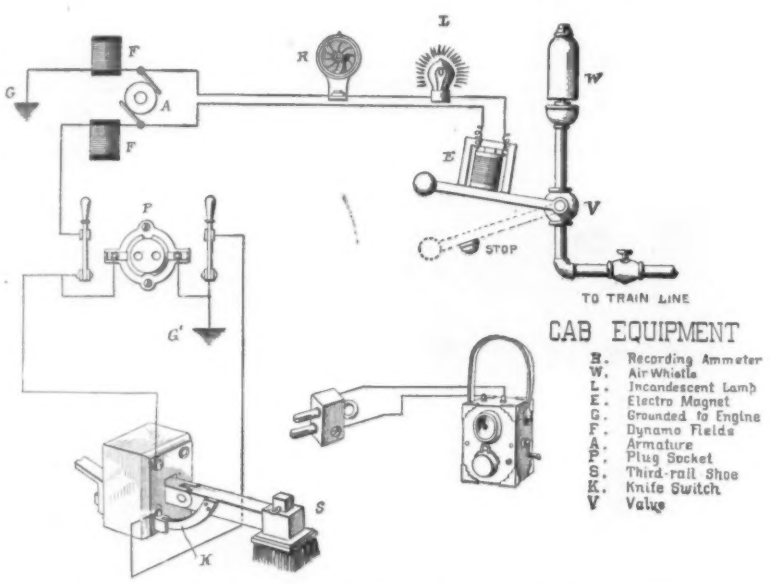


Fig. 1.—DIAGRAM OF ELECTRICAL APPARATUS AND CONNECTIONS ON THE CAB OF THE LOCOMOTIVE.

The accompanying diagrams illustrate the equipment used. On the locomotive there is a shunt-wound dynamo, driven by a small steam turbine, which is supplied with steam from the boiler. In series with the armature *A* of this dynamo is an incandescent lamp *L*, a recording ammeter *R*, and an electro-magnet *E*, which serves normally to hold the arm of valve *V* on the airbrake pipe of the train. The fields *F* of the dynamo have their circuit completed through the metal frame of the locomotive. Should the field circuit be interrupted the magnet *E* would be de-energized, permitting the valve *V* to open, thus putting on the brakes and blowing the whistle *W* with air from the train line. At the same time the lamp *L* would be extinguished and the ammeter would record the time when the interruption occurred. The field circuit is grounded in the locomotive at *G* and *G'*. Between the fields and the ground *G'* is a knife switch *K* mounted on a third-rail shoe *S*. At the side of each block extending for a distance say of fifty feet is a rail *T* (Fig. 2). When the shoe *S* engages this rail it is lifted, opening the switch *K* and interrupting the circuit of the fields through the locomotive. However, the circuit of the fields would not open unless there should happen to be a broken rail or a train in the next block.

Alongside the track are two lines, *C* and *D*, one of which is connected at intervals with the rails of the track while the other is connected with the third rail sections *T*. These lines, *C* and *D*, run to a station house where the circuit is completed through a switch that may be opened by the engineer in charge of the house whenever he desires to stop the trains along the system under his control. The line *C* contains a switch *a* for each block section, which is held in closed position against the tension of a spring by means of an electro-magnet R^1. The latter is connected in series with the rails of the track and is energized by a battery *B* at the opposite end of the block system. In case of a breakage in one of the rails, or should a switch be thrown open, the magnet R^1 would be de-energized, permitting the switch *a* to open and thereby break the field circuit of the dynamo on the approaching train, with the consequent setting of the brakes as described above. The same result would follow if the circuit through the magnet *R* should be short-circuited by a train on the block. At *P* (Fig. 1) is a plug socket adapted to receive the telephone plug connection. The telephone circuit is completed past the switches *a* through a coil R^2. This resistance permits the passage of the alternating current of the magneto and telephone, but prevents the passage of the direct current to the dynamo so that telephonic communication is not interrupted by the block system.

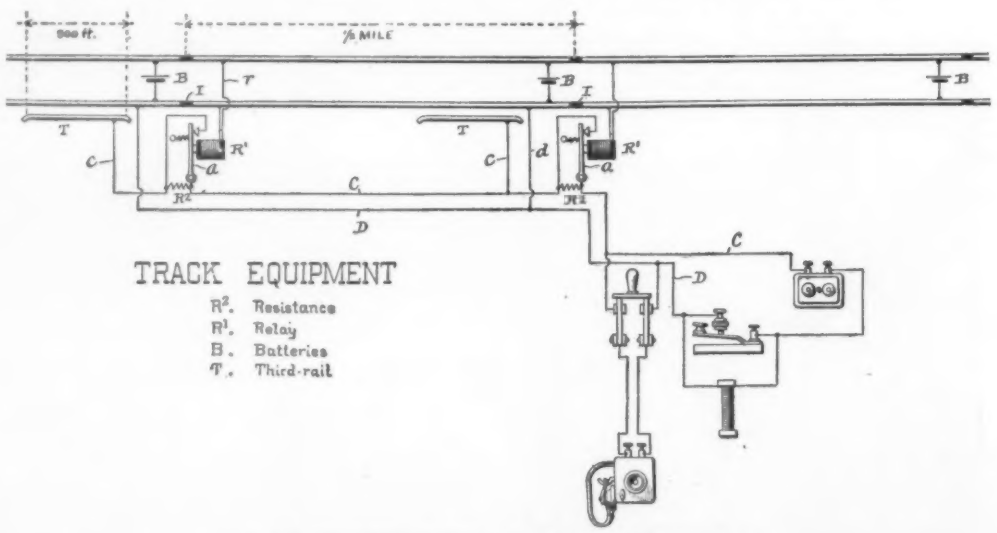


Fig. 2.—THE TRACK SAFETY AND TELEPHONE CIRCUITS.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

BUTTON-FASTENER.—H. G. C. HÖRNING, New York, N. Y. The fastener quickly fastens a button in place on a garment by the use of a pin engaging and holding the button and adapted to be passed through the cloth of the garment, the pin engaging a retaining device on the back of the garment and preferably formed of a plate having a head and neck for engagement by the U-shaped end of the pin to fasten the pin and plate together.

Electrical Devices.

SWITCH-PLUG.—P. C. EWING, Little Rock, Ark. In this improved construction, the inventor permanently connects the cord to the plug, so that the cord extends from the plug at approximately an angle of ninety degrees. The plug remains in a horizontal position when in use and out of use, and the movement of the plug from one position to the other, does not cause binding of the cord at its point of connection with the plug.

Of Interest to Farmers.

GRADER.—J. W. BEASLEY, Modesto, Cal. By the use of this mechanism the earth is plowed and delivered to an elevator and distributer; plowed dirt is delivered at each side of the machine alternately so that it may be distributed or received in a conveyor for removal, the delivery being manually controlled; the receiving drum guides the delivery belts and forms a driving member therefor and delivers the dirt from the interior of the drum upon the belts; and the manually-operated controls command the operating mechanism.

Of General Interest.

WALL-MOLD.—E. W. COLLINS, Fort Dodge, Iowa. This invention pertains to cement or concrete walls, and its object is to provide a new and improved wall-mold for use in building a monolithic concrete wall, with or without air spaces, and with a facing of a different, finer material to enhance the appearance of the wall.

MATCH-CASE.—B. EPSTEIN, New York, N. Y. This invention relates to match cases, particularly to such as are adapted to be carried in the pocket. The device is especially to be used as a case for matches which are permanently attached to a card-board sheet or holder, and which are adapted to be torn off one by one when used. These matches are attached at their lower edges to the lower edge of a flap, and this projects in a direction in which the heads of the matches lie.

WALL.—M. B. ENSMINGER and J. W. SHAFFER, Fostoria, Ohio. In the present patent the invention has reference to improvements in walls, and it has for its object the provision of a construction whereby there is an air-space between the blocks forming the wall and the plaster-boards or laths, without its being necessary to veneer the blocks.

FIRE-ESCAPE LADDER.—W. A. FARMER, Arcade, N. Y. This collapsible ladder may be conveniently stored adjacent to a window, and is adapted to be readily adjusted out of the window in case of a fire. It is strong, of light weight, easily manipulated, and will automatically space itself from the side of the building, so as to leave room on the rungs for the hands and feet of the user.

VAGINAL SYRINGE.—O. KATZENBERGER, Chicago, Ill. This invention is more especially designed for use in spraying medicinal powders onto the diseased parts and arranged to permit conveniently charging the powder container of the syringe with powder, to insure a proper spraying and spreading of the powder and to provide an escape for the air pressure from the parts.

ORE-SEPARATOR.—G. W. KUNKEL, King City, Mo. When the toothed cam wheels rotate the feed end of the screen frame will have imparted thereto a series of rapid vertical impulses, while the frame will be vibrated rapidly in a horizontal plane and in a longitudinal direction by one of the cam wheels, the wheels moving the frame one direction and springs in the opposite. As the ore is fed onto the feed end of the screen a jumping motion is imparted thereto, tending to move coarser particles above the finer, permitting them to pass through the screen, while the ore travels longitudinally of the screen by action of the cam wheels.

BEER-TAPPER.—W. W. FRISHOLM, Leadville, Col. The invention relates to that type of tapper in which the valve is fitted in the bushing of the bung hole; and the patentee provides a novel arrangement of valve casing as securing devices and passages with a view of facilitating the operation and the action of the tapper in controlling the fluid to be drawn.

DRINK-SHAKER. — J. HEINRICHS, New York, N. Y. The invention relates to drink mixers, and its object is to provide a shaker, more especially designed for use in making cocktails, milk punches and like drinks, and arranged to allow convenient mixing and cooling of the ingredients and straining and pouring of the drink into a glass.

ORE-MILL.—T. C. HISTED, Shawnee, Okla. In this case the invention is an improved mill for reducing ores containing precious metals, particularly quartz ores of both hard and soft varieties. It combines the functions of a stamp mill and a grinder, in that it is adapted to hammer the ore so as to break it into small pieces and then grind and crush it into smaller particles.

HOLDER AND MEASURING DEVICE FOR GRANULAR MATERIAL.—A. A. HAUTY, Chicago, Ill. In the present patent the purpose of the inventor is to provide a receptacle for granular material such as tea, and combine therewith novel, simple, and convenient means for measuring and discharging a quantity of the contents of the receptacle into a vessel for use.

ADJUSTABLE CURVE-RULER.—C. O. HARPER, Omaha, Neb. The invention consists of an abscissa ruler or straight edge, a spring ruler, and ordinate rulers adjustable laterally and arranged at the opposite end portions and at an intermediate point of the spring ruler, and the outer ordinate rulers having pivotal portions connecting them to and adjustable along the length of the spring ruler.

PAPER-BAG HOLDER.—J. W. DUNNIGAN, Altoona, Pa. The object of the invention is to provide a cheap and serviceable rotating paper bag holder which will furnish a maximum of separate holders in a minimum of space, and wherein each size of bag will be in a separate bunch and may be easily got at and removed. It is the only rotating bag holder ever devised, and being triangular in shape, gives three sides that revolve in the space of one.

VAPOR-EXTRACTOR FOR USE IN TREATING WHISKY-BARRELS.—B. H. HUBBERT, Highlandtown, Md. The invention is a vapor extractor for use in treating whisky barrels, and in operation, steam or other medium may be introduced through the inlet pipe to operate upon the interior of the barrel, and then be discharged through the ports and the body and outlet in the operation of the apparatus.

WATER-GLASS-GAGE CUTTER.—F. BLODGETT, Butte, Mont. This instrument cuts glass tubing from the inside thereof, to form water gage columns; the cutter may be set to sever an article to the size desired; it is adapted to cut the inside surface of a tube, having means for exerting an outward pressure upon the point of operation; and the parts of the implement are held and returned to their normal position by automatic means.

Hardware and Tools.

LAWN-SPRINKLER.—G. H. CHOATE, Hailey, Idaho. This invention provides a sprinkler which may be placed beside a foot-path for a house to irrigate the lawn without wetting the walk or house; provides one which may be secured in position by the operator without necessitating the suspension of the flow; and one of a structure diminutive and easily handled.

STEP-LADDER.—W. J. BLUNDELL, New York, N. Y. This invention relates more particularly to that type of ladder disclosed in a prior patent granted to Mr. Blundell. One object of the present invention is to so construct the side rails and legs of the ladder that each may be separated into two sections, and one of the sections replaced by a shorter section to produce a step-ladder of shorter length.

CLASP.—A. O. BOYLAND, Aurora, Neb. In the construction of this clasp the applicant provides a pivoted jaw having a spring tongue at its pivot end for holding the jaw closed, and at the opposite end a cam device is provided which co-acts to maintain the tongue in its holding position.

BOLT AND NUT LOCK.—C. H. FERGUSON, Jersey City, N. J. More particularly the invention refers to a nut lock in which there is employed a plate or washer having a yoke which may be bent up to partially inclose the nut, or at least engage with a plurality of sides of the latter. The plate is so formed that it is automatically held against rotation and serves not only to lock the nut in place but may also lock either the bolt or a second nut, or all three.

Heating and Lighting.

SAFETY-PLUG.—E. H. BASTION, Fairbury, Ill. The object here is to provide a plug, for convenient attachment to the crown sheet, fire sheet, or other part of a boiler, to indicate danger in case of low water level, and arranged to prevent the fusible material from being dislodged or blown out of the plug body by pressure in the boiler, to insure an even heating of the fusible metal core, to prevent the plug body from being clogged up by sediment, and to provide a ready flow of molten metal out of the body of the plug and permit free escape of pressure to relieve the boiler of undue strain.

TANK-HEATER.—W. TINKER, Anamoose, N. D. The aim of this inventor is to provide a means for heating the water in a tank or reservoir, the heater to be partially submerged in the water, and having means for supplying fuel, and for permitting the removal of ashes, and the entrance of sufficient air to properly consume the fuel.

Household Utilities.

CRADLE.—L. VARGAS, New York, N. Y. This improvement is in motor-actuated cradles, and has in view a cradle supported to oscillate about an approximately central vertical axis, the cradle in its preferred construction having an annular track on the under side which is arranged to be alternately engaged at opposite sides by wheels or segmental gears driven by the motor.

GARBAGE-CAN.—W. B. OSBORN, Clarksburg, W. Va. The main purpose of the invention is to provide a garbage can which has a hinged cover pivoted in such a manner that it may be raised by foot pressure, thereby permitting the use of both hands in transmitting the garbage into or removing the garbage from the receptacle.

Machines and Mechanical Devices.

BOTTLE-WASHER.—R. J. PFEIFER, Callicoon, N. Y. This invention refers to bottle washers and fillers, and the object of the invention is to provide an apparatus of simple construction, in which a number of bottles can be rapidly washed and refilled, and when the bottles in the frame are filled it descends and the bottles can be removed for corking.

BUILDING-BLOCK MOLD.—C. J. T. CORDES, Waldwick, N. J. This mold is adapted to make blocks of different sizes. The invention contemplates an arrangement in which the sides or walls of the mold may be moved outwardly so as to enlarge the mold, and the mechanism includes means for moving some of the walls in unison so that the cores for the block are advanced automatically into position.

PIANO-SWELL.—SARAH W. CLARK, New York, N. Y. It has been found that the movement of the lid by mechanism concealed from the audience often operated to distract its attention from the music and constituted a disturbing element. In the present patent the inventor avoids this objection by providing means within the casing of the instrument and entirely concealed from the audience, for controlling the volume of sound. Her new mechanism is separate and distinct from the lid of the instrument.

LIQUID-EJECTING APPARATUS.—H. K. SMITH, Union, S. C. In the present patent the invention is an improvement in apparatus for dispensing liquids adapted for use in ejecting soda water syrups and mineral waters and other liquids. The fountain construction in this apparatus forms the subject of a separate application for patent which Mr. Smith is about to file.

LIQUID-DISPENSING APPARATUS.—H. K. SMITH, Union, S. C. In this case the invention is an improvement in apparatus for dispensing liquids, adapted for use in dispensing soda water syrups and mineral waters and other liquids. The present patent is a divisional application of Mr. Smith's prior application filed in the United States Patent Office.

CABLE-CLAMP.—C. A. BUTLER, Bartlesville, Okla. In the present patent the object of the invention is the provision of a new and improved cable clamp, more especially designed for use on well-drilling tools and other devices, and arranged to securely clamp the cable and to positively hold the same against slipping.

METER-BOX.—L. P. ANDREWS, Sedalia, Mo. One object of this inventor is to provide a box, which serves as a protection for the meter incased therein, which can be easily opened to permit the meter to be read, the closure of which can be locked securely in place to prevent accidental or unauthorized opening thereof, and which is substantially water tight.

Prime Movers and Their Accessories.

CARBURETER.—P. J. DASEY, New York, N. Y. This invention has reference to carbureters such as used in connection with gas engines. The object of the improvement is to produce a carbureter having an improved construction which operates to draw the air in a concentrated current directly across the fuel opening from the admission valve.

Railways and Their Accessories.

SPARK-ARRESTER AND DRAFT-REGULATOR FOR LOCOMOTIVES.—R. J. HARLE, Tanta, Egypt. The aim in this patent is to provide an attachment for distributing products of combustion more evenly, or causing them to pass through the lower flues as well as the upper, and also for arresting the sparks, which under other circumstances, would reach the smokestack and be discharged therefrom. It effects considerable economy in coal consumption.

RAILWAY-CROSSING.—A. H. HAVARD, Urbana, Ill. In this instance the invention has reference to railroad crossings, and it has for an object the provision of a crossing for railroads, adapted to minimize the amount of noise occasioned when a train is passing over the crossing, and the said crossing being safe and efficient.

Pertaining to Vehicles.

DUST-PROOF SELF-OILER FOR AXLES.—J. J. MCGUIRE, New York, N. Y. This invention relates to wheels such as carried by carts and wagons. The object of the improvement is the production of a wheel having an axle box which will be self-oiling and substantially dust-proof. The absorbent material placed in the dust chamber is preferably formed of lamp wick or similar woven material.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th, 1909, or will be sent by mail on request.

(12206) E. J. B. asks: A said that a bullet shot in the air (the carrying power of the rifle being one mile), after reaching its limit will return to the earth just the same as if you were a mile in the air and shot a bullet from the same rifle toward the earth. B says that the bullet shot from same rifle one mile toward the earth will reach the earth sooner than the bullet dropped from a mile in the air. A. If a bullet is shot from a rifle so that it rises a mile into the air, it will be for an instant at rest at a point a mile above the earth, and neither rising nor falling. It will immediately begin to fall as if from rest, and fall a mile to the earth. It will strike the earth with the velocity acquired by a fall of one mile through the air. This will not be the same as free fall, since the air will retard its fall somewhat. If a rifle at a height of one mile above the earth discharges a bullet vertically toward the earth, the bullet will have two forces acting upon it, the force of the powder and the force of gravity, both urging it downward, and its velocity will be that given by the sum of the two forces. It will reach the earth in much less time than would be required for a falling ball. A is wrong and B is right.

(12207) W. I. S. asks: Please advise when the twentieth century began, whether on the first day of January, 1900, or January 1, 1901. A. The twentieth century began at midnight of the morning of January 1st, 1901. The year 1900 was the hundredth year of the nineteenth century. Begin and count from one, and you will find that 100 is the last number of the first hundred; so 1900 is the last number of the nineteen hundredth of numbers or centuries.

(12208) G. P. asks: Will you kindly inform me as to the construction of the siren whistles as used on the United States navy boats? Some tell me they consist of a disk having slits cut between the center and circumference, which is caused to whirl by steam pressure; others say not. While not a yearly subscriber, I get your valuable paper from the newsstand, and would very much appreciate a reply to this inquiry. A. Sirens are made very much as you describe, although round holes are more frequent in the larger sizes than slits. There are two plates, the lower stationary and the upper revolving. In the lower the holes are vertical, and in the upper they are inclined all at the same angle, but the lower end of the holes in the upper plate register with those in the lower when still. When steam is turned on, the upper plate is revolved exactly as a windmill is blown round, and the faster it turns the more frequently the holes register, cutting off and passing the steam alternately. This causes vibrations of shorter and shorter period to be applied to the bell of the whistle, giving a higher and higher note, till the steam is cut off, when the note descends in the same way.

(12209) T. A. G. asks: Can a circle be squared? If so, how can it be done? I have read in papers about people working on it for years and could not do it. Is it only a joke, or are those people in my class and don't know how to count? What I mean is, to square a circle of any size down to the very finest square the fingers can make. A. A square of exactly the same area as that of a given circle cannot be constructed; in other words, one side of a square whose area shall be equal to that of a given circle cannot be found by the use of drawing instruments. A number of approximate solutions have been made. The area of a circle is found by multiplying the circumference by half the radius. The circumference is found by multiplying the diameter by the number 3.1415926536, etc., a number which never comes to an end, and which has been computed to a very large number of decimal places. Now since the circumference cannot be exactly found, the area cannot be exactly found, and the side of the equivalent square cannot be exactly found.

(12210) C. W. asks: I would like very much to have you explain how it is possible for an ice boat to go faster than the wind. I am quite sure it does this, though I have not the instruments to prove it. If it does, it appears to be contrary to the laws of conservation of energy. A. An ice boat, sailing before the wind, does not go swifter than the wind. That is impossible, even when we take account of the small friction of ice. It will retard the boat somewhat. But when the boat sails near the wind, the line followed by the boat is longer than the distance the wind travels while pushing the boat a distance equal to its length, and so the boat moves farther than the wind moves in the same time. You will find the point discussed in our SUPPLEMENT, No. 214.

NEW BOOKS, ETC.

THE GAS TURBINE. Progress in the Design and Construction of Turbines Operated by Gases of Combustion. By Henry Harrison Suplee, B. Sc. Philadelphia: J. B. Lippincott Company. Pp. 262. Amply illustrated.

In view of the rapid advancement in the development of the gas turbine, the literature upon this important subject must be regarded as quite inadequate. Hence the value of the present work by Mr. Suplee, whose name is synonymous with very thorough, accurate, and illuminative work in literature of this character. Although the gas turbine was one of the earlier forms of the combustion motor, the high temperature and high rotative speed involved have rendered the mechanical problems connected with centrifugal action so difficult of solution, that progress has been slow compared with that in the production of the steam turbine. Nevertheless, some very effective experimental work, to say nothing of theoretical investigation, has been done during the past few years by English, French, German, and American scientists. Unfortunately, most of the information regarding this work is in a form unavailable for the practical engineer and investigator. The theoretical discussions are to be found chiefly in the transactions of professional societies, and the practical work has been done behind closed doors. In the present work Mr. Suplee has gathered under one cover the most important papers which have appeared upon the subject of the gas turbine, together with some account of the work done in America. To this has been added such information upon actual experimental machines as could be secured. The various papers are prefaced by an historical chapter of great interest, which throws much light upon the early history of the gas turbine, which the reader will be surprised to learn dates back in its primitive form to the medieval "smoke jack," which has been attributed to Leonardo da Vinci. Of equal historical interest is the information that Barber, in a British patent of 1791, completely anticipated nearly all the most recent developments in gas turbine practice. The illustrations, chiefly line cuts, are numerous, and the tables and diagrams afford just that exact information of which the inventor and experimentalist is in need. We commend this work as a most valuable addition to the too scanty literature upon this subject.

PAINTS FOR STEEL STRUCTURES. By Houston Lowe. New York: John Wiley & Sons, 1910. 16mo.; 109 pp. Price, $1.

About thirty years ago practice in the making of linseed oil, varnishes, japans, and colors first brought the writer into daily contact with questions regarding the manipulation of paint, its properties and the results of the various operations to which it was subjected. Painters, engineers, architects, builders, and constructors have since been continuously asking questions whose answers involved thought and experiment. At one time paint making was an art, then it became a trick, now it is a science. This little handbook is written by a paint maker and is the direct result of study recently given to the manufacture and properties of structural steel and the use of paint in its preservation. During the ten years which have passed since the first edition of this book the author has continued his observations, experiments and tests on a more elaborate scale than ever before and with careful attention to every point needing consideration. The book appears to be a most valuable one.

AMERICAN MANUAL OF PHOTOGRAPHY. New York: George Murphy Incorporated, publisher, 1910. 8vo.; 328 pp. Price, 75 cents in paper, $1.25 in cloth; postage 15 and 20 cents extra.

This volume, which is No. 24, is edited by John A. Tennant. It is filled, as usual, with valuable photographic hints and is beautifully illustrated. It will be warmly received by all amateurs.

VEHICLES OF THE AIR. By Victor Longhead. Chicago: Reilly & Britton, 1910. 8vo.; pp. 479; 270 illustrations and diagrams. Price, $2.75 postpaid.

This book fully meets the demand for a popular, semi-technical treatise on mechanical flight. Its author is, above all else, a thoroughly practical man and one who has had wide experience with automobiles and their motors. As a result of this, the chapters of his book on power plants and transmission mechanism are very illuminating. The various kinds of lighter-than-air and heavier-than-air flying craft are illustrated and described in detail, and the whys and wherefores of different forms of construction are made known. Many details of aeroplane construction are given in a clear and concise manner and illustrated by diagrams. Fifteen leading aeroplanes are described in detail, most of them with the aid of scale drawings and handsome large half-tone engravings. The author discusses the work of the pioneers of aerial flight, and so thoroughly does he go into some of the burning questions of the hour, such as wing-warping and the like, that he publishes the complete patent specifications of Lilienthal, Chanute, Monillard, Wright, and Montgomery. The last-named gentleman's paper on "Principles in Wing Formation and the Phenomenon of Soaring," which was prepared for the Aeronautical Congress in 1907 as the outcome of a paper in the SCIENTIFIC AMERICAN SUPPLEMENT two years before, is also printed in full and will be found extremely interesting. A very complete list of flights made up to November, 1909, is one of the many excellent features of this work.

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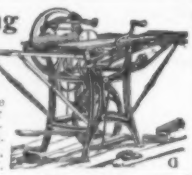

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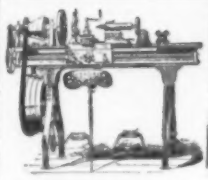

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AND EACH BEARING THAT DATE

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THE ROCK-HEWN CITY OF PETRA.

(*Concluded from page 221.*)

peoples of the land. These "high places" were the subjects of many warnings to the children of Israel. There are other high places in the vicinity of Petra.

Still another interesting ruin is of the so-called Ed-Deir (the convent), and is reached by an hour's hard climbing along ravines and up rock-hewn staircases, to the northwest of Kasr Farioun. Passing the striking Tomb of the Lions, we reach at last the high plateau on which stands Ed-Deir. It is nearly 150 feet long and almost as high, being similar to the Khazneh, having its double rows of six columns each, but widened by corner-pilasters on both sides and on both stories. On this plateau there are several places of sacrifice and a fine view of Mount Hor to the southwest.

The early history of Petra is hidden in the mists of remote antiquity. It was probably the capital of Edom. Its first mention is in sacred history in II Kings, 14:7, which records its conquest by Amaziah in the ninth century B. C. From Is., 16:1, we learn that it was then, about 700 B. C., held by Moab. It is evidently referred to in several prophetic denunciations whose fulfilment has been most literal. About 300 B. C. it had come into possession of the warlike Nabataeans, descendants of Nebaioth the eldest son of Ishmael, who made it their capital, and it was known to the Greeks as Petra. Strabo, the Greek traveler and historian, describes it at the end of the last century B. C., as also did Pliny, the Roman writer, in the first century of our era. In A. D. 60 Aretas IV., King of Petra, had extended his conquests to Damascus and is referred to by St. Paul in II Cor., 11:32. In 105 A. D., in the reign of Trajan, it passed under Roman rule. Ecclesiastical historians in about the fourth century mention it as a Christian metropolis. It continued populous and prosperous as a trade depot until about the beginning of the fourth century, when the caravan routes from the north, which had for so many centuries led past its arched portal to the Red Sea, were diverted to the Persian Gulf. After this it rapidly declined, and it is not heard of again until about A. D. 536. Even its very existence and site were forgotten, until it was visited and identified by Seetzen in 1807, and explored and described by Burckhardt in 1812, the latter gaining access to it, as he also did to Mecca, in the disguise of a Moslem pilgrim.

Treasure Hunting.

(*Continued from page 222.*)

a noted Lake diver, devised a diving suit strengthened with metal rings to support the rubber against the enormous water pressure. In this suit Pelky made a successful exploration of the ship, but on his second descent his suit collapsed, and he was hauled up dead.

Even this fatal accident did not deter wreckers from planning further attempts on the immense cargo of copper at the bottom of the lake. A famous diver of Duluth, Minn., M. F. Chalk by name, was invited to go down, and to tempt him to make the venture $2,500 were offered him before he went down, and a written promise that he would get one-half the net returns from the wreck. In addition to this his life was to be insured for $20,000 for the benefit of his family. But after making an examination of the location and the depth of the water, Chalk refused this flattering offer.

Many accounts of great depths to which divers have descended to inspect wrecks and help to recover treasures must be accepted with a little grain of salt. For instance, John Haggerty, who went down to inspect the steamship "Oregon," wrecked off Fire Island, was generally reported to have reached a depth of 125 feet. But to disprove this the hydrographic charts show that the depth of water where the steamer sunk was only 104 feet. Other remarkable diving feats

(*Continued on page 228.*)

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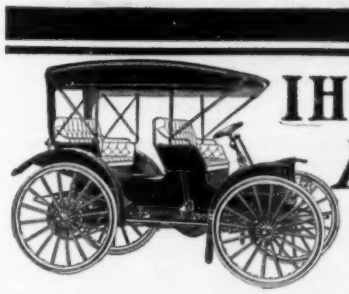

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Scientific American No. 6, Volume XCIX. **The Mystery of Comets.** An article in which the famous comets of the last century are enumerated and described and modern cometary theories discussed.

Scientific American Supplement No. 1728. **Ancient and Popular Ideas about Comets.** Queer superstitions about the strangest of heavenly bodies.

Scientific American No. 7, Volume CI. **Halley's Comet.** An interesting article by Dr. Alexander W. Roberts, in which the general history of Halley's famous comet is sketched with comments on its past appearances.

Scientific American Supplement No. 1705. **The next apparition (1910) of Halley's Comet.** An important article by H. C. Wilson, with a map giving the position of the comet relatively to the orbits of the planets from September 15, 1908, to July 13, 1910.

Scientific American Supplement No. 1632. **Halley's Comet.** An article by F. W. Henkel, F. R. A. S., which tells how Halley came to discover the comet which bears his name, and how mathematicians have plotted its orbit.

Scientific American Supplement No. 1770. **Edmund Halley.** A biography by J. E. Gore, M. R. I. A., of the man who dispelled cometary superstitions and popularized the law of gravition.

Scientific American Supplement No. 1773. **Light Pressure and Comets' Tails.** An explanation of the vagaries of a comet's tail, by Arthur Stanley Eddington, F. R. A. S.

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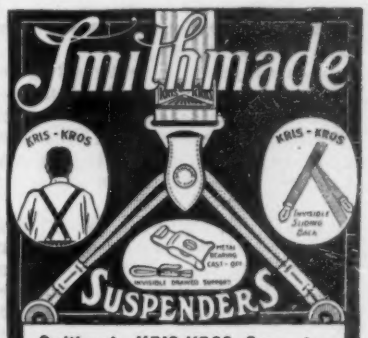

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(*Continued from page 227.*)

must also be accepted with a slight allowance for exaggeration.

In recent years deep-water salvage of treasure ships has excited the cupidity of divers, adventurers, and business men. There is altogether too much wealth lost under the water to suit us. Here is what an expert diver and wrecker has to say on the subject:

"Within fifty miles of Sandy Hook there is wealth enough sunk in the ocean sand to stock the United States Treasury. All the private treasure ever buried in the earth would be a trifle by the side of it. The bottoms of both the Atlantic and Pacific Oceans are vast treasure beds. The man who can devise a means of traversing the ocean bottom might rival Rockefeller. A vast amount of treasure is as accurately located as the banks of Wall Street. Any experienced diver can take you to a chart, and lay his fingers on any one of twenty spots and say, 'Go to longitude so-and-so in a latitude definable within fifty feet, dive deep and bring up a fortune.' Only you can't dive deep enough. A great deal of this treasure is the deposit of recent years. Still more went down before the days of ocean liners. At one time specie was transported in men-of-war. Gold dust and diamonds were shipped from mines on rickety schooners for want of better craft."

In twenty years there were nearly five thousand wrecks on the Great Lakes. Of these over one-fifth, or approximately one thousand, were total losses. The total cargo losses on these wrecks are estimated at $12,000,000, and much of it is in indestructible form of property. These tragedies on the lakes go back to 1680, when La Salle's ship, the "Griffon," disappeared in Lake Huron with $12,000 in coin. Besides the "Pewabic," which went down with half a million dollars' worth of copper, the steamers "R. G. Coburn" and "City of Detroit" were lost off Saginaw Bay in 1871 and 1873, with cargoes of copper aboard worth at least $50,000 each. None of this treasure has been recovered. The steamer "William Home," which sunk in 1895 off Swishwah Point, Lake Michigan, carried to the bottom $20,000 worth of steel billets, and the steamer "Clarion," lost in 1851 between Cleveland and Detroit, carried a deck load of new locomotives to the bottom. Iron and coal cargoes have been distributed freely over the bottom of the Great Lakes, and some day the miners of these ores, equipped with improved diving dress, may recover good-sized fortunes from the bottom of the lakes.

Lake Huron is considered the greatest scene of treasure hunting, and it is commonly spoken of in the lumber camps as "The Lake of Sunken Treasures." The reason for this is that back in the early lumbering days large sums of money were shipped to the numerous lumber camps in small vessels, and literally dozens of these were lost. All of this money lies somewhere at the bottom of the lake for the treasure hunter to find.

Among the many important wrecks of treasure ships which are partially or exactly located on the charts of the government, mention should be made of the Pacific Mail steamship, "Golden Gate," sunk near Manzanilla, Mexico, with $600,000 in gold coin and bullion, and the Klondike steamer "Islander," sunk off Douglas Island, Alaska, with $375,000 in gold dust. The greatest prize of all sunken treasures—if all is true which history records—is the Spanish galleon which went down five miles off Lizard Point on the Cornish coast, in 1784, with $85,000,000 in gold. The Spanish flagship "San Pedro" was another rich prize, carrying to the bottom of Cumana Bay, Venezuela, $2,000,000, and the ship "Central American" went down off Havana with a similar amount in gold. The steamship "Lexington," which went down in Long Island Sound, was reported to have contained $300,000 in specie.

The record of these sunken treasure

(*Concluded on page 229.*)

Cadillac once more proves itself most economical car

Remarkable record submitted by 75 Cadillac "Thirty" owners in New York metropolitan district who have driven their cars 398,884 miles at a total cost for mechanical repairs of $53.21, averaging 71 cents per car.

Equivalent to 16 times around the world—398,884 miles—at a total repair cost of $53.21!

That is the amazing record revealed by statistics just compiled from the experiences of 75 Cadillac "Thirty" owners in New York City and vicinity.

It is doubtful if the entire history of travel and transportation—steam, electric or gasoline—can show a case of parallel economy.

There was in this instance no special striving to attain a minimum.

The 75 owners went their separate ways with their 75 Cadillac "Thirty" cars, each without reference to the other.

They took no special precautions, but drove where they pleased, when they pleased, how they pleased; without the slightest idea that their experience was to be made a matter of record.

At the close of 1909 statistics were collected and compiled from the signed statements of the 75 users.

It was found that the 75 cars had traveled a total distance of 398,884 miles, or a distance equivalent to 16 trips around the world.

Forty-six of the owners had no repair cost whatever—not a single penny—in spite of the fact that some of them had driven their cars as much as 18,000 miles.

The highest individual repair charge for the year was that of one user, whose car cost him—for special reasons which did not reflect upon the construction in any way—$10, the distance it carried being 9,000 miles.

Eleven of the others expended during the year from 25 cents to 50 cents. The average distance traveled was 5,318 miles per car, yet the average repair expense was less than 71 cents per car.

The signed statements of these 75 users showed further that the average gasoline consumption for the touring cars was one gallon for each 15 miles of travel and one quart of oil for each 175 miles of travel. The Demi-Tonneau cars showed an average of 17½ miles for each gallon of gasoline and 200 miles for each quart of oil. Some users obtained 20 or more miles for each gallon of gasoline, but the figures first given are averages.

There is no disguising the fact that this record has proved a revelation, even to automobile manufacturers themselves.

It proves beyond a doubt what the Cadillac Company has always maintained, that the elements in motor car construction which are absolutely necessary to economy and immunity from repairs are scientific design, standardization, accuracy of workmanship and correct alignment. Also that necessity for repairs is the result of poor design, inaccuracy of workmanship, ill-fitting and incorrectly aligned parts.

A year or more ago they proved before the Royal Automobile Club of London that three Cadillacs could be torn down; all the parts thrown in a pile; a portion of these parts discarded and new ones substituted, and the three cars built up again from the heap of parts to run with absolute sweetness and without so much as an iota of looseness.

For this the Cadillac was awarded the Dewar Trophy.

And now comes another demonstration which simply emphasizes the fact that the convictions of the Cadillac Company as to the essentials of a long-lived, serviceable and economical car are correct.

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The present work presents twenty points of view, all of them interesting and no two quite alike. Each essay is 2500 words in length. The reading of one essay does not involve the reading of the entire work, yet the entire book gives a comprehensive view of what the layman wishes to know about the Fourth Dimension. No abstract mathematics will be found in the volume. The essayists endeavor the explain to Fourth Dimension both by imagining the effect of transporting an ordinary third-dimensional human being into fourth-dimensional space and also by explaining a third-dimensional man's possibilities in one and two dimensional space.

Professor Manning, the leading American authority on the subject of the Fourth Dimension, contributes an introduction in which he explains how the concept of the Fourth Dimension gained mathematical prominence, and swiftly reviews the work that has been done in the field. He has also edited the essays and supplied explanatory footnotes where required.

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Scientific American Supplements 1575, 1576, and 1577 contain a paper by Philip L. Wormley, Jr., on cement mortar and concrete, their preparation and use for farm purposes. The paper exhaustively discusses the making of mortar and concrete, depositing of concrete, facing concrete, wood forms, concrete sidewalks, details of construction of reinforced concrete posts.

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(*Concluded from page 228.*)

ships along our two coasts and Great Lakes could be extended indefinitely. Some of the treasure has been recovered, such as the boxes of gold lost in the Spanish steamship "Mercedes," sunk near the Canary Islands, but in most cases very little, if any, of the money has ever been brought up by divers.

There have been strenuous efforts made to salvage these known wrecks, and inventors have been busy for half a century devising means of getting at the wealth lost under the water. The aluminium diving suit that resembles ancient armor, with articulated joints at the shoulders, knees, and hips, is one of the new inventions designed to make deep-sea diving practical. With this armored suit divers expect to reach a depth of 250 feet without experiencing any great difficulty in resisting the pressure. The pressure of water on the joints of this armored diving dress was so great that ball bearings of harder material than aluminium were found necessary. The aluminium suit protects the diver from the water pressure, and at great depths the armor is so light in weight that a man can walk around easily with it on. In addition to the articulated armor suit, the diver is provided with an intricate system of hooks operated by the hands from the inside, so that his work can be performed without exposing any part of the body. The diver is provided with a telephone, a headlight, and an apparatus which registers the amount of air sent down through the breathing tube. The wreckers from above can thus tell at all times the condition of the diver.

The science of salvage as conducted by modern wrecking companies in the raising of ships is a matter totally outside of that of raising sunken treasures. The ships laden with their treasures have for the most part been in the water so long that to raise them by compressed air would be impossible. Their rotten decks and timbers would explode and burst asunder long before sufficient air could be pumped into them to raise them from their muddy beds. Consequently, the salvage of treasure-laden ships of the past is purely a matter of deep-sea diving. The diver who can go down the deepest and remain there the longest is the one who will receive the gratest reward for his venture.

Even with a diving dress that will protect the diver from the great water pressure, and with all the equipments of lights, hooks, telephone, and air-registering device, the man who descends to great depths must encounter other perils of a blood-curdling nature. Rotting decks and timbers may set a trap for him through which he may fall to his death. Long tunnels through deserted cabins and hulls, filled with floating objects, may tangle up his tube through which fresh air reaches him, and within a space of a few minutes death by suffocation follows. There are grisly wolves of the ocean to encounter in some seas, veritable man-eating sharks, and other death-dealing monsters of the deep. A single false step may precipitate death, and yet time is precious and speed of action must be attained. Dark, lonesome hulls must be examined, intricate cabins broken into, and not infrequently the golden treasures must be dug out of the sand and mud into which they have buried themselves. Altogether it is a grewsome experience, and one that keeps the strongest man's nerves a-tingle. There are few sights which can equal the interior of a sunken ship, whose ribs have been rotting beneath the ocean's waves for a century or more. Some timbers are so well preserved that they cannot be broken easily with an ax, and others so decayed that a diver can thrust a hand through them as easily as a knife goes through cheese.

The diver earns all the wealth that he gets from a sunken treasure ship, and only the hardest and most expert divers will undertake this work. They prefer as a rule to stick to ordinary wrecking in water forty to fifty feet deep.

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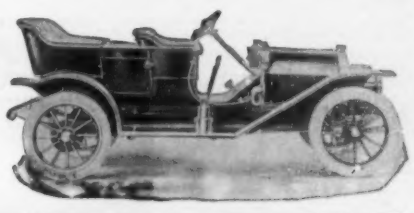

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By A. RUSSELL BOND

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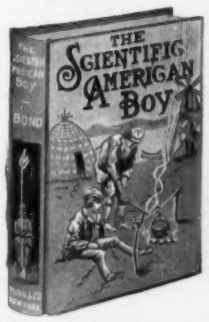

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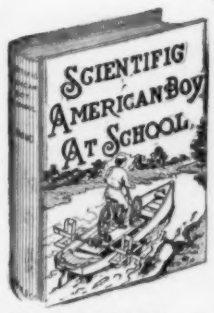

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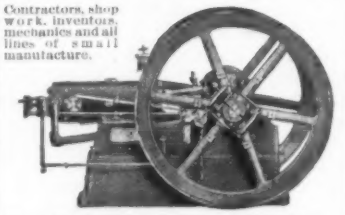

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Snow melting machine, H. F. Cuntz	950,895
Soap shaving or granulating device, J. N. Riggs	950,959
Spark plug, S. B. Fowler	950,847
Speedometer, L. E. Blanchard	950,853
Spike clamp and fastener, H. O. Crippen	950,841
Spindle. See Bobbin spindle.	
Spinning and twisting device, yarn, V. Belanger	950,507
Splice bar, T. C. Lackland	951,009
Sprayer, tree, F. G. Hayes	950,916
Spreading machine, I. C. Fielden	950,617
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Spring wheel, A. R. Miskin	950,942
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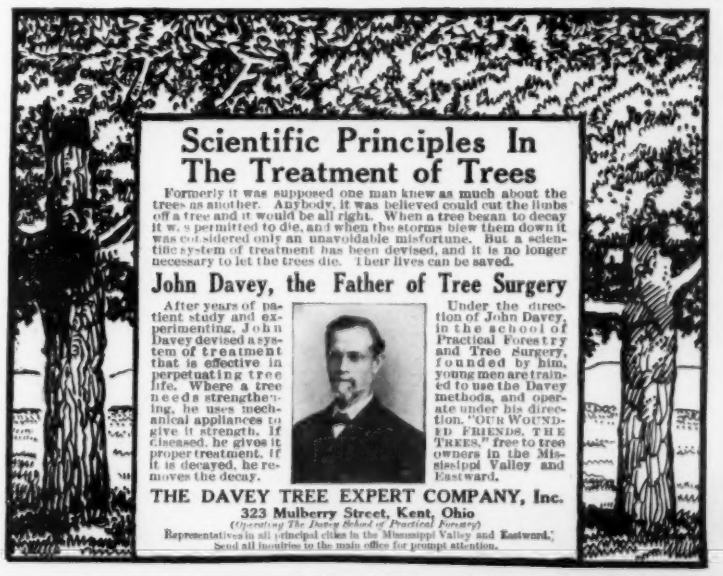
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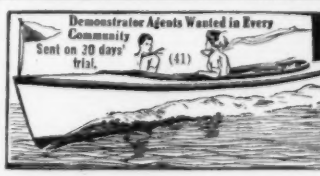

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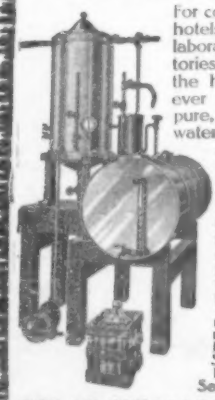

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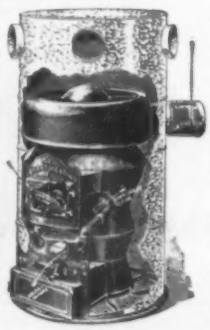

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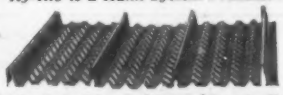

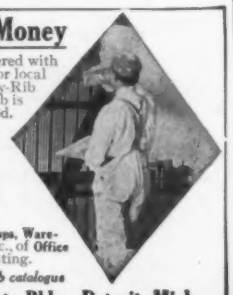

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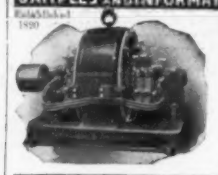

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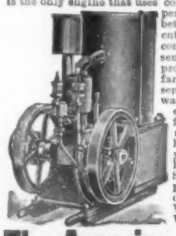

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